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TELEPHONE SERVICE.

More than one newspaper in New York City is still carrying on an agitation for lower telephone rates. Intrinsically, there can be no objection to that any more than there can be to an agitation for lower prices at the opera, for cheaper ice, cheaper coal, or other convenience or commodity. We all want things cheaper. Heaven for some divine purpose implanted that desire in the breast of mankind just as it did the other desire to derive all the income that the traffic can stand. As between these opposed tendencies the happy mean is usually found, but it certainly is not discovered by all who are hammering away at this telephone question. The assumptions and arguments as to the low rates at which telephone service can be given are positively absurd and ridiculous, and even when accurate bear no relation to the point at issue. For example, a grave, sober commercial and financial organ quoted with approval last week as bearing on the rates in New York the hearsay remark that at Cambridge, O., you got good service for $17 a year. What has that to do with the case? Where can any reasonable comparison come in between New York City and Cambridge, O.? Besides, if it did come in, is it not equally true that in Greater New York as low a telephone subscription rate as $24 a year obtains?

As a matter of fact, the independent telephone movement which has been doing so much to educate people up to the use of the telephone, has been seriously hampered and imperilled by this very matter of low rates. Within the last week or two, several exchanges with thousands of subscribers, west and south, have sold out, generally at a severe loss to the investor, because when they started to give an opposition service, their rates were put too low to be profitable. This danger was pointed out time and again in these pages, and it still impends in far too many instances. And now another stage of the controversy appears, for finding that the independent exchanges that intend to survive are gradually advancing their flat rates or else are adopting the more scientific "metered" service, the very rabid advocates of dirt-cheap telephony are beginning to talk about the city ownership of telephone systems. One or two such municipal exchanges already exist, on a very small scale, in this country, and there will probably be more in the near future. But we can hardly believe that in cities like Chicago or New York ideas of that character can prevail. Even as it is, Chicago cannot light its own streets decently or cheaply, and New York's efforts to inaugurate an underground railway system under the management of Tammany Hall have not had such a result so far as to promise a possibility of creating a further charge on the taxpayer in the shape of a municipal telephone exchange.

MUNICIPAL KEROSENE.

When once you start to paternalize or municipalize industries, it is difficult to tell where to stop. There are so many things a government can do badly that it hardly seems fair to make invidious distinctions in picking out opportunities for extravagant employment of the taxpayer's money; and this is the sentiment which pervades the breast of every true socialist. Last week Dr. Maltbie when addressing an audience in this city on the beauties of English municipal

ownership, struck such a condition of mind in his audience. One gray-haired man arose and asked the Doctor whether or not kerosene oil should be sold by the city governments. "I burn kerosene," he said, "because I can't afford gas. If the municipal ownership of gas is right, the municipal ownership of kerosene is right, too." Thereupon burst forth a dispute as to what socialists do or do not believe in, but that aside, our kerosene friend seems to have right on his side—granting the postulate that a city or state government ought to venture into business at all. In fact, he does not go far enough. A good many people in this country burn candles, and somehow it doesn't seem quite right not to have municipal candleshops as well as municipal electric light plants.

A paragraph on this general subject in our correspondence from England this week will be found very interesting. Some of the British corporations having baked their own sour bread—and possibly brewed their own flat beer—others are seeking the power to make their own dynamos as well as to carry on their own telephone exchanges. This growing tendency or desire to have the government do everything may be one of the reasons for the curious weakness shown recently by England in many ways, and which might be seriously regarded by some people as likely to affect at no distant date the stability of an empire built up by the rugged individualism of trader, soldier and sailor.

TELPHERAGE.

One of the most striking of the recent changes in New York City due to the general adoption of electricity appears so far to have escaped criticism. It is the clearing away of the whole cable system which at one time promised to become the sole method of car propulsion within the limits of New York and Brooklyn. As a matter of fact, it is as though the cable had never been, for outside of electricity and a few compressed air cars of apparently dubious future, only a few horses still linger on a few subsidiary lines awaiting the time also for their banishment from the street railway field. Moreover, what has happened in New York has happened in every other city in the Union and all over the world. Electricity is absolutely victorious and the cable is permanently worsted. Those who predicted ten years ago that this would occur, hardly expected to find their predictions so soon come true.

The point we would now make upon this undeniable state of facts, is that the time is ripe for the invasion of other fields where the cable has meantime been having its own way. We refer to aerial lines of transportation, of which there are certainly many hundreds, and it may run into thousands. Before the trolley system got well started, many interesting attempts were made to operate electrically what the late Fleeming Jenkin dubbed "telpher" lines, competing with aerial cable haulage methods, but the electrical art was then all too young for success. Electrical inventors and engineers had not learned the rudiments of traction and transportation. Besides that, they could not build good small motors; they were unfamiliar with devices for contact and control; and further than that, the pressing needs of the surface traction field absorbed all the available energy, ability and capital.

To-day all these things have changed in favor of electricity, and we are fain to believe that the times are ripe for the practical introduction of telpherage work. The past ten years has witnessed an enormous utilization of wire cable for freight and even passenger suspension haulage, but as compared with electricity, the objections to the cable all remain as before. While it is perhaps difficult for a telpher motor to climb a very steep wire grade, on the other hand, it is even more difficult for the cable to take in curves or blunt angles. With the cable as before, there is a large part of the power to be expended in hauling the rope itself, whereas with electricity the power is applied directly to the propulsion of the loaded skips or cars. In short, this is, it seems to us, one of the fields for immediate occupancy, in which intelligent work will be attended by the most satisfactory results. These new fields electricity must have of necessity not because, Alexander like, it yearns ambitiously for further conquest, but because, like the rolling tide of human invasion, it can do far better with the country occupied than was done by its preceding inhabitants. Electricity is so distinctly superior to a hauled cable for power transmission there can now, in view of the improvements in the electrical arts, be no doubt whatever that telpherage will shortly do much of the aerial work done by the cable, ranging from the mine to the dry goods store, and furnishing a most valuable auxiliary to rural trolley and post office routes.

A UNIQUE CASE OF PARALLEL CONNECTED ALTERNATORS.

In the correspondence on another page there will be found a letter from Mr. H. G. Stott, of the Buffalo General Electric Company, containing a statement which is laid down as a general proposition concerning the operation of alternators in parallel with each other, this statement differing kuite radically from generally accepted ideas on this subject. Mr. Stott claims that the division of the load between two alternators can be determined by adjusting their relative field strengths before throwing them in parallel, but cannot be changed by any variation of their field after they are switched together. The generally accepted idea, which is borne out by practice, is that the adjustment of the division of the load depends not upon the relative field strength either before or after the machines are in parallel, but upon the load-speed characteristics of the prime movers.

In the case, for instance, of two similar alternators direct-coupled to two steam engines, the machines when in parallel must make with mathematical exactness the same number of revolutions per minute. If the load upon the two sets is, for instance, 500 kilowatts and the governor of one engine admits sufficient steam to generate 100 kilowatts at the same speed that the governor of the other engine admits sufficient steam for 400 kilowatts, the load will divide itself in this ratio, no matter what may be done with the generator fields, either before or after synchronizing. It is obvious that a change of the relative field strength of the two machines cannot in any way affect the governors if the load upon the busbars remains constant. All the energy derived from the steam entering either engine minus the internal losses of the generating unit must appear in the electrical circuits. Thus the division of the load is independent of the relative strength of the exciting currents in the two fields. If the division of the load upon the alternators could be changed by strengthening one field and weakening the other, it would obviously be a plain violation of the law of conservation of energy since the postion of the engine cut-offs would remain the same, and it is obvious that the output of one machine cannot be materially raised and that of the other lowered, the indicated horse-power of each remaining constant. In case the exciting currents in the two fields differ, the machines adjust themselves to practically the same field strength by an exchange of wattless currents which pull down the voltage of that with the stronger field, and pull up that with the weaker field until the two are equal.

Mr. Stott upholds his argument with results obtained from experience, but this experience (although not so stated in his letter) is with two machines, each of which is driven by a synchronous motor, these synchronous motors running in parallel with each other on 25-cycle Niagara power. This gives a very peculiar case of parallel running not to be found in any other installation in this country, if in the world. There is no chance for slip in the machines since they are both direct-coupled and the motors must remain

mathematically in synchronism with each other since they are driven by the same alternating currents. The phase relation of the generating ends thus depends upon the relative drag and consequent relative field distortion of the motor ends. A similar case would only be met in steam or water-wheel practice where the governors of the two machines running in parallel not only maintain isochronous speed at all loads, but also when this speed is mathematically the same for one governor as for the other. This case of course never occur.

Mr. Stott's letter indicates that in the peculiar case of his machines the division of the load cannot be changed by adjusting the field of the generators after they have been thrown together, but can only be properly proportioned before they are switched together by sending as great an exciting current into the field winding of the fresh machine as is already passing through the exciting circuit of the machine under load. This is a peculiar performance that would not be anticipated, at first sight at least, and which requires for its explanation consideration of the actions of both motor and generator.

THE STORAGE BATTERY.

The history of the electric storage battery and its applications is only a few decades old, and yet it would be most interesting to read, even if the facts were set forth with all the monotonous chill of unvitalized statistics. Only as recently as six or seven years ago there was no storage battery installation in this country on any large scale. The reputation of the storage battery was at the lowest ebb among central station managers, and they could say nothing too bad for it. It used to be remarked that a man who acted as advocate for storage batteries was apt to economize truth, and that the man who acted as an advocate for the properties of aluminum was apt to disregard truth, so that if an aluminum storage battery were to be introduced in place of the lead storage battery, the combination of the two might make Ananiases of the whole electrical community.

At the present time, the storage battery has three main fields of usefulness; namely, the maintenance of a nearly uniform pressure in electric distributing mains, the replacement of prime movers in central stations during the peak of an irregular daily load, and the delivery of energy at a distance from its source, as in electric traction, cars, automobiles, etc. In each of these applications the storage battery is now firmly established, and in many cases these applications overlap or are united in a single plant. The change of opinion among station managers and the recent high favor of storage plants has not, however, been due in any marked degree to the increased output of storage cells when first charged and discharged, but rather to improvements in manufacture, whereby the depreciation has been reduced to commercial limits. The limitations in the use of storage batteries for traction purposes are, however, clearly defined at the present day, owing to the weight of their material. This material is nominally lead in the form of plates submerged in dilute sulphuric acid and contained in insulating jars. From a strictly chemical standpoint the useful substance is lead peroxide. From either point of view, lead and lead peroxide are among the heaviest substances in commercial use. Large sums of money have already been expended by experimentalists in endeavoring to find a cheaper storage medium for electrical energy, but up to the present time without success.

It is wonderful that in spite of the great weight of storage batteries they have found favor in electric traction to such an extent as to come into use for automobiles and yachts. The facts may be expressed in round numbers as follows: Any quantity, say one pound avoirdupois, of petroleum contains chemical energy sufficient—if all expended on raising its mass—to lift it through a vertical distance of about 3000 miles against sea level gravitation (considering the diminution of the earth's gravitation at increasing distances, this 3000 miles would be increased to about 4000, so that for comparative purposes it is simplest to assume constant sea-level gravitation). A pound of good coal has chemical energy within it sufficient to lift it about 2000 miles; a pound of gunpowder about 200 miles, and a pound of storage batteries (allowing a discharge of 6 watt-hours per pound of cell) has enough electric energy in it to raise its weight about three miles. Consequently a storage battery is potentially 1000 times weaker than petroleum, although of course the petroleum is consumed by use, whereas, the storage battery is only discharged; and it should also be remembered that the energy of petroleum can only be obtained by means of thermodynamic engines whose efficiency is much less than the efficiency of a storage battery and electric motor. Considering this wonderful theoretical disparity, amounting to roughly a thousand to one, it is remarkable that the storage battery should be in the field at all. The fact that it is in the field is due to the great simplicity and convenience of the electric motor equipment, as compared with the complexity of the engine used with petroleum, not to speak of its odor, which is often too distressing for words.

It is not impossible that a substitute might be found for peroxide of lead in the electric storage battery cell. Judging, however, from the enormous amount of effort expended upon the cheap metals, it is questionable whether a cheap substitute can be expected in the near future. If, however, a comparatively expensive material can be found, possessing a high electrochemical storage capacity, it might not be impossible to utilize it commercially for automobile purposes, because a great deal of money could be expended on the first cost of a battery to save the carrying about of so much lead for the privilege of using its peroxide. There would be but little danger of stealing the chemical, with ordinary care, because it would always be under lock and key, and the conditions are quite different from those attending the use of expensive materials in line construction. Thus, iron-wire street railway bonds are used in preference to copper-wire bonds in some southern cities of this country, owing to the attraction which copper wire has for low-caste negroes in whom the sense of *meum* and *tuum* is somewhat rudimentary.

We constantly hear, however, of the wonderful energy storing powers of some new inventor's lead storage battery, and many intelligent persons are annually deceived by specious and misleading statements in this direction. It is true that every year finds an elementary knowledge of physics and physical principles more generally diffused among the community, but the opportunities to mislead are great, owing to the dreadful complexity of our systems of weights and measures. It requires much more knowledge and much more training in an English-speaking country to arrive at the facts concerning physical principles, from tables printed in books, than it does in other civilized countries where the metric system is in universal use. For example, an unskilled person is apt to find the output of storage batteries stated in watt-hours per pound, the output of coal in British thermal units per pound, that of petroleum in evaporating power in pounds of water from and at 212° F., and the output of gunpowder in foot-tons per ounce or pound. The whole combination is appalling and the complexity is all artificially created by diversity in the systems of weights and measures that we unfortunately retain against the demands of utility. It is quite true that a sudden change from the British systems to the metric system of weights and measures would be disastrous in expense to the mechanic arts, but this argument appeals only to the swiftness with which the change is made, and not to the decision as to whether a change should be made at all. It is earnestly to be hoped that Congress will before long deal with this vexed question and take steps to introduce the metric system into practical use at some future date.

The Recent New York Gas and Electric Consolidation.

President Gawtry, of the Consolidated Gas Company, has issued a circular to stockholders in regard to consolidating the lighting, heating and power interests of New York City. The circular is particularly interesting as explaining the deal and indicating the trend of affairs in this field, and is the more interesting to electrical people as coming from a representative gas official. He says: The rapid growth of electricity for light and power is observed by every one, and the annual consumption of gas, per meter, for light, is gradually but surely diminishing. It has long been apparent to your trustees that the interests of your company would best be served and protected by its being placed in a position to supply electricity as well as gas. After mature consideration, it was decided to unite the electrical with the gas business, and negotiations which have been pending for many months resulted in action by your Board of Trustees, unanimously taken on Jan. 2 last, whereby there was acquired for your company the entire capital stock of $36,000,000 of the New York Gas & Electric Light, Heat & Power Company.

There had been previously acquired, in the interest of your company, a controlling interest in the property of the United Electric Light & Power Company, the Brush Electric Illuminating Company and the United States Illuminating Company. In addition to the foregoing, there has also been obtained the ownership of the Consolidated Telegraph & Electrical Subway Company, which owns 900 miles of ducts and subways for electric lighting and power purposes.

An examination of the business of the New York Gas & Electric Light, Heat & Power Company showed that the net earnings of that company were upon a basis of 4 per centum upon its capital stock. The business and franchises of the companies thus acquired enable your company to be a large factor in the business of supplying electric light and power to the City of New York.

The property acquired by these purchases will enable the Consolidated Gas Company to largely reduce the expenses of its electric lighting business, to extend the same, and to bring it into more general use by the community, and to derive large benefits from the rapidly increasing use of electricity for power, and gives to the company a great future in the lighting business without calling for any payment from its gas business.

The New York Gas & Electric Light, Heat & Power Company has contracted for and is now building the largest power house in the world, which, when completed, will have a capacity equivalent to 1,500,000 16-cp lamps, with a gross earning capacity of more than $15,000,000. The Electric Company has on hand the cash to pay for the construction of this plant.

With regard to the above statement from President Gawtry, it may be added that to consummate this purchase the trustees issued debentures for $36,000,000, payable in ten years, but redeemable at the option of the Consolidated Company within six months, at the company's option, in the company's capital stock at $232 a share. The trustees recommend that an issue of 155,172 shares be made for this purpose.

Direct English Cable to the Azores.

One of the first results of the new relations between England and Portugal will be a concession through which a cable will be laid from the Azores direct to England and worked by British operators. In this way the Azores will assume the character of a lookout point for the British navy, whence news could be instantly despatched to England and thence to British naval stations in other parts of the world. It is stated that ever since the Spanish-American war the British representative in Portugal has been most anxious to secure this concession. It was then demonstrated by the bewilderment of the Washington government regarding the whereabouts of Cervera's squadron that the performance of the Portuguese cable line running to the Azores would be equally inadequate should Great Britain ever be placed in a position similar to that of the United States. For a time British diplomacy made no headway in Lisbon, owing to the fact that Germany desired a similar concession. Moreover, the Portuguese government had suddenly become alive to the Azores as a position of great political and commercial value. At length the Cortes was moved to give its approval to a scheme for laying cables from the Azores to Halifax and Germany, but the lines were to be operated by the Portuguese. With the accomplishment of this undertaking it was expected that Portuguese trade would be sure to benefit largely. It was also apparent that some advantage would accrue to British commerce, but it was at the same time realized that for naval purposes it would be most hazardous to trust to the quick transmission of urgent telegraphic despatches over cables exclusively under Portuguese control. And so without questioning the integrity of England's ancient allies or disputing that their notions of speed differed from her own, the British representative in Lisbon kept persistently at work until he has now secured for his government the exclusive privilege above noted.

Mr. Riker Before the Automobile Club.

At the meeting of the Automobile Club of America, on Feb. 10, at its rooms in the Waldorf-Astoria, Mr. A. L. Riker gave an interesting and instructive paper on the subject of the electric automobile, illustrated from his own well known work in that field, with the aid of lantern and blackboard. Mr. Riker claimed that the "hay motor" or horse, and the electric motor, were the only two which could automatically overcome changes in their work; all others requiring some manipulation, however slight. Another feature they possessed in common was the ability to exert the greatest tractive effort at the lowest speed. Again, the fact that you could greatly overload them for short periods is common only to these two powers.

Mr. Riker dealt in detail with the controller, batteries, motors, gear, brakes and other features of electric automobiles, and speaking of the charge said that he had never known any one to run out of current if they only watched the meter readings and were sensible enough to go home at the right time. He pointed out the advantages of specific forms of controller, etc., and the method of turning corners in various ways of controlling the wheels. As to radius of action, there were on the market to-day electric vehicles capable of making from 50 to 75 miles on each charge of the battery. He had a report of a carriage in France that had covered 108 miles on a single charge. It weighed complete about 2200 pounds. He believed that inside of six months an electric vehicle would be produced which not exceeding 1000 pounds in weight would be capable of carrying two passengers 50 miles on one charge. As to the assertion made in regard to the electric vehicle that the cost of operation was as high as 5 cents a mile, he quoted figures from actual records of a vehicle running since 1897 until now. During that period it has covered over 20,000 miles. The cost of battery maintenance has been $150, or three-fourths of a cent per mile. The current supplied at 10 cents per horse-power hour has cost 1¾ cents per mile, making the total cost 2½ cents actual, as against the theoretical 5. He believed that with fairly assumable conditions this cost would soon be worked down to 1½ cents. Mr. Riker summed up his arguments for the electric vehicle by saying that it was the only carriage a lady could operate, and it appealed more than any other to aesthetic tastes. He concluded by throwing on a screen pictures of a number of very handsome electric vehicles for business and pleasure. About an hour was given up to discussion, in which Messrs. Shattuck, C. J. Field, Hazelton and Dr. S. S. Wheeler participated, the durability and efficiency of storage batteries being the question most agitated.

A Hospital Electrical Laboratory.

The St. Louis hospital at Paris has erected a laboratory for radiography and electrotherapeutics with funds donated by the father and widow of the late Dr. Brault. On the ground floor are the waiting and examination rooms and a laboratory for micrography, and on the floor above are rooms for electrotherapeutics, photography and radiography.

Canal Electric Haulage in France.

An experiment is being made with electric haulage on a section of the French Canal du Nord near Bethune. The haulage apparatus has the form of a tricycle with large wheels, and carries a motor which receives current by means of a double trolley from conductors laid along the line of the canal. The canalboat is attached to the haulage wagon by means of an ordinary tow-line, the wagon being in charge of a motorman. Four or five boats of 300 tons each can be hauled at the rate of two miles per hour.

An English Direct Current High Tension Central Station.

IN England several central stations have recently been installed, the service of which would in this country be considered to demand without any question the employment of alternating currents. A system has, however, been worked out in that country which consists in the distribution of direct current at high voltage and its transformation to service voltage by means of dynamotors, which in England appear to go by the name of "variable-ratio transformers."

The accompanying illustrations refer to a plant of this system recently installed at Bromley, Kent. The district covered includes the town of Bromley, which offers a fairly compact load, chiefly from shops and a large hotel. There are a few private houses using the electric lights here, but the large residential districts are removed by a distance of from three to five miles from the centre of the town. The village of Chiselhurst, 2¾ miles distant, and intervening districts are also supplied from the station.

The 210-volt three-wire system was decided upon as the best adapted to the district in question, and the station was located in the centre of the Bromley district and adjoining the premises of a large hotel which is the most extensive consumer. At Chiselhurst a substation has been located to which current is transmitted from Bromley at 2000 volts, and there converted by special dynamotors to 420 volts for distribution on the three-wire system. The converters at this station are supplemented by a storage battery of relatively large capacity.

The general disposition of the station is shown in Fig. 2. The boilers are of the Davy-Paxman type, with dimensions of 14 ft. x 8 in., and each has a heating surface of 1180 sq. ft. They are fed by two Worthington pumps, each capable of supplying 12,000 lbs. of water per hour. No injectors have been fitted. A feed heater (rated at 12,000 lbs. of water per hour) is employed to soften the feed water and to heat it with the exhaust steam; but as the steam passing out of the feed heater is at present more than it should be in view of the central position of the station, a surface condenser and cooling tower are included in extensions projected. Water will have to be obtained from the street mains both for feeding purposes and condensing.

The steam piping is of wrought steel, with welded seams, the heavy forged flanges having been screwed on hot and brazed. The pipes are 7 in. and 5 in., and arranged on the ring main system, with the usual number of valves and two steam traps. The exhaust pipes are of cast iron, and are laid in trenches under the floor of the engine house. The feed pipes are in duplicate, with the valves arranged so that either boiler can be filled by either pump with hot or cold water. The exposed parts of the boilers and pipes are covered with "Magnesia" non-conducting composition.

The three generating sets are of the usual Belliss-Parker fast-speed two-pole undertype design. A Parker combination three-wire balance and booster is employed, the two machines constituting the balancer and the two boosters being all on one shaft. The former can give a balancing current of 50 amperes, and each of the latter can raise the pressure by 70 volts and pass a current of 70 amperes. The overhead traveler is for a load of 5 tons.

The low-pressure switchboard is of a stereotyped design which, although excellent in many respects, has its disadvantages, the most noticeable of which is that there is no provision for adjusting the pressure at individual feeding points. All the feeders are brought to the same busbars merely through ammeters and fuses, and no account can be taken of the varying drop of pressure along the feeders to different districts. This will probably be troublesome as the "residential load" increases, for its maximum will not coincide in point of time with the maximum load in the central and business quarters; and, moreover, the extent of the load from private houses is extremely difficult to foresee, so that the feeders to the

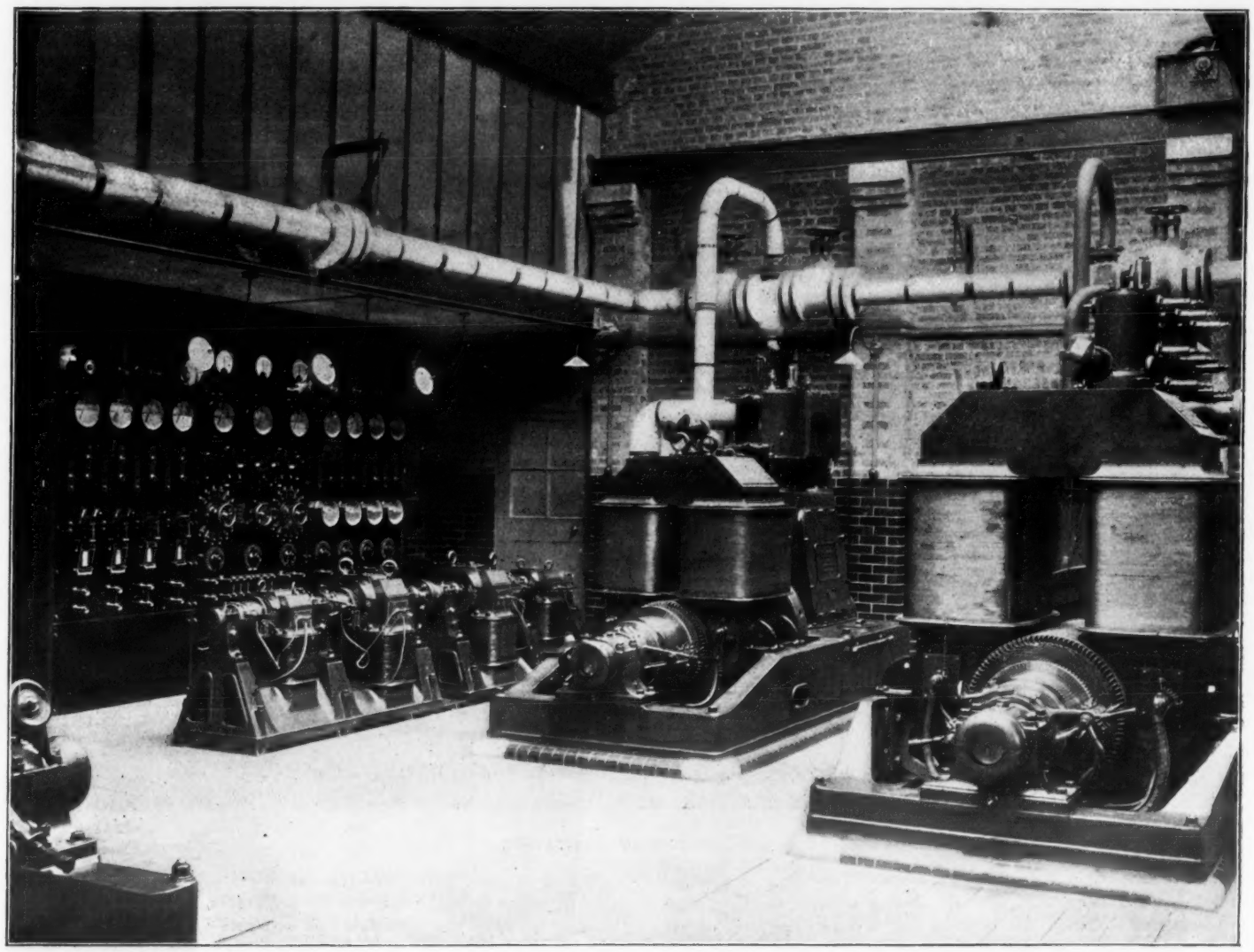


FIG. 1.—VIEW OF LOW PRESSURE BROMLEY GENERATING STATION.

various districts cannot possibly be calculated for equal loss in pressure. Some modification of the switchboard to meet this difficulty is contemplated, possibly the addition of adjustable iron wire resistances between the feeders and the busbars. Pilot wires from the feeding points to the station will also be a necessary adjunct. Kelvin instruments and Thomson watt-hour meters are employed on the switchboard, and there are two large 18-in. dial engine room voltmeters in a prominent position over the doorway. Minimum cutouts are only employed when shutting down, and can be pinned up very easily.

There are 230 storage battery cells with a capacity of 650 ampere-hours at 80 amperes, and capable of discharging at 120 amperes without injury.

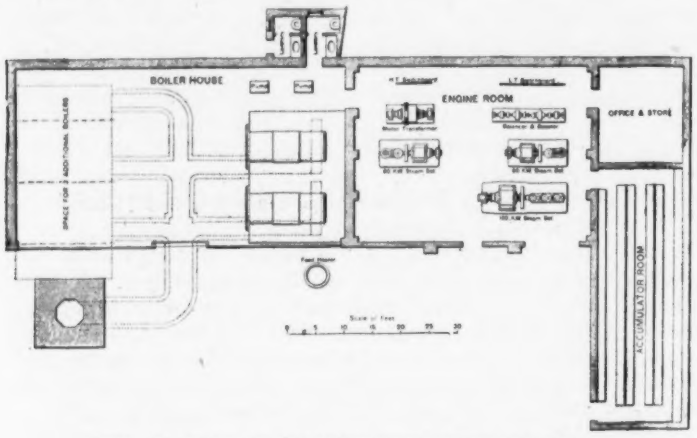


FIG. 2.—PLAN OF BROMLEY GENERATING STATION.

The dynamotor or "variable-ratio continuous-current transformer" is seen in Figs. 6 and 8, but a clearer idea of its general design is obtained from Fig. 6, which shows its hinged pole-pieces opened for the removal of the armature. In ordinary cases it is unnecessary to provide for a variable ratio of transformation, but where the high-pressure feeders are long, and where consequently there is a considerable fall of potential between the generating station and substation at full load, it is necessary to be able to increase or decrease the transformation ratio. For this purpose the arrangement illustrated is made use of. Fig. 7 is a diagram of the armature winding, from

ture. These poles have supplementary windings, in series with which a rheostat is connected. By adjusting this resistance, the relative number of lines of force passing through the two armatures is varied, and thus, as is easily understood, the transformation ratio is also varied. Both the machines at Chiselhurst and the converter at Bromley are of this pattern, and this is the first time that this type has been employed. Similar machines, but with the auxiliary poles rising independently from the bedplate, have been used before, one of them being installed by the Charing Cross & Strand Electricity Supply Corporation.

The Bromley machine is capable of being used as a step-up or step-down transformer, its pressure ranging from 2000 to 2100 volts

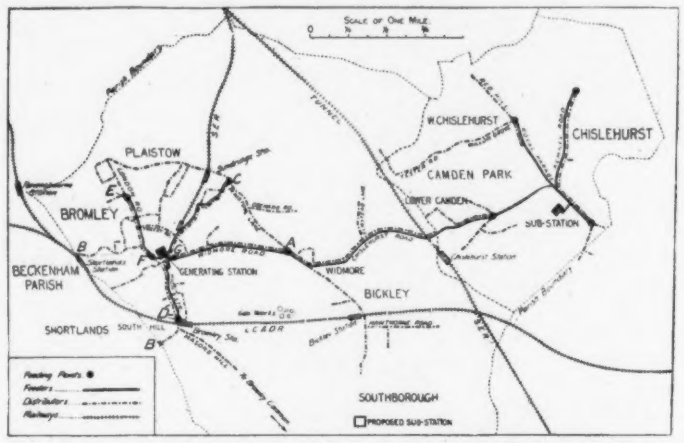


FIG. 4.—BOUNDARIES OF BROMLEY AND CHISELHURST PARISHES.

and from 420 to 450 volts, the maximum currents being 22 amperes at high-pressure and 105 on the low-pressure side. The speed is 600 r. p. m. The Chiselhurst machines are only employed for stepping down, and are of the same size as the Bromley one. They are guaranteed to give the full pressure of 450 volts at the secondary with a primary pressure of 1900 volts.

A view of the high-pressure switchboard is given in Fig. 1. Its arrangement is very simple, but it would be an improvement if the breaks were longer and if the metal work of the board were better protected, for a 2000-volt continuous-current shock may be fatal.

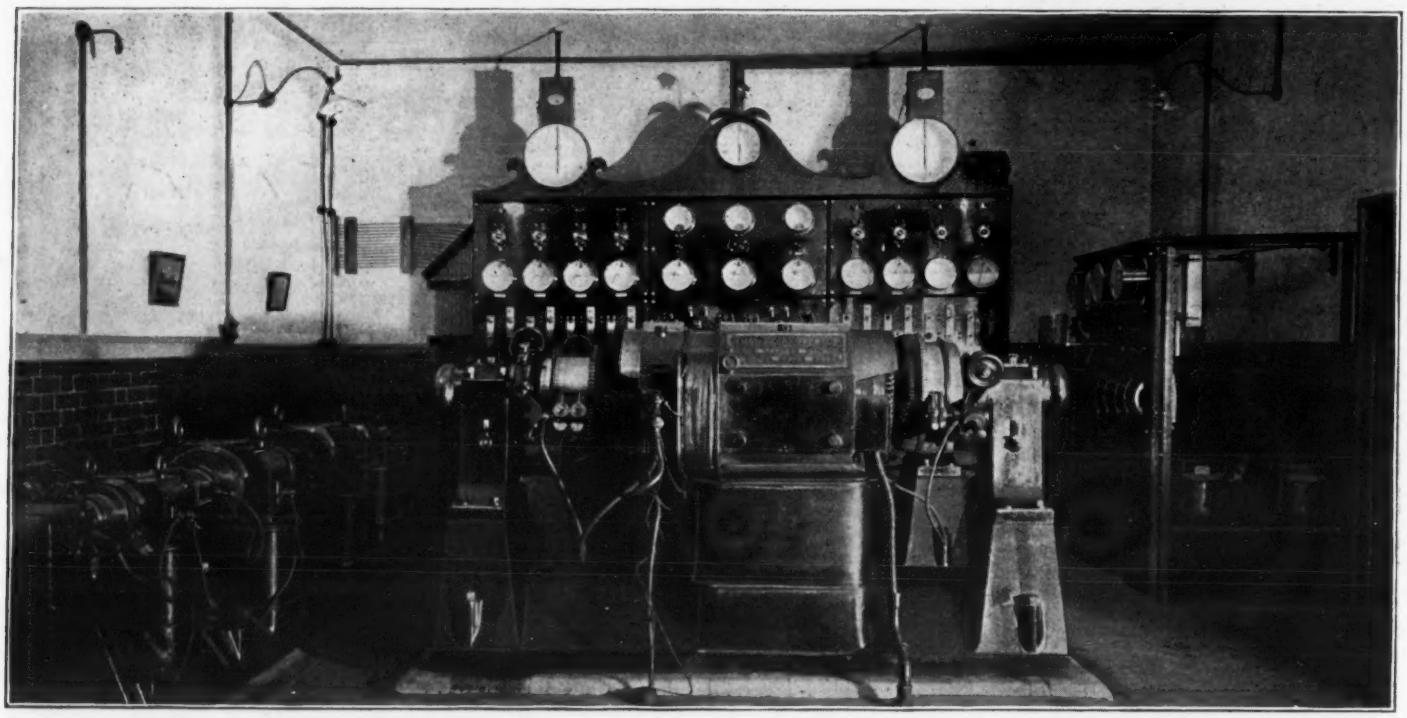


FIG. 3.—CHISELHURST SUBSTATION.

which it is seen that the high-pressure armature winding, connected to the left-hand commutator, extends over a shorter distance than the low-pressure winding, the latter being wound over the former and there being a second core for the prolonged part of the low-pressure winding. Referring to Fig. 6, or to the diagram, Fig. 7, it is seen that there are two auxiliary poles, diverted from the main field and covering the low-pressure but not the high-pressure arma-

The plates of glass in front of the switches are not sufficient, and an enclosure of the contacts would be far preferable. At the back also the distances between the bare fuses of opposite polarity and the iron frame of the board are too short, especially at the Chiselhurst station. Some alterations, including the interposition of shields of asbestos card and the bringing out of some of the terminals farther from the board, have improved it somewhat, however. Another

modification at Bromley has been the bending down of the spring of the zero cutout, as this appliance was found unnecessary.

The map in Fig. 4 shows the boundaries of the Bromley and Chiselhurst parishes, and gives a good idea of the configuration of the district. It should be added that the Bromley Urban District extends 1½ miles farther south than the bottom of the map, but this part has been omitted, as no mains have been laid there yet. Both the feeders and distributers are shown, and are distinguished by full and chain-dotted lines. A high-pressure feeder runs from Bromley to Chiselhurst. It is two-wire and duplicated. The four single cables are each of 0.05 sq. in. copper, insulated with Callender's vulcanized bitumen and laid in bridges in a cast-iron trough filled "solid" with bitumen. The low-pressure networks of the Bromley and Chiselhurst stations are quite distinct, although in the course of time they will probably meet one another at several points. The directors adopted the policy of laying down mains in several streets before the houses were built, with the result that the majority of the houses that are put up are wired for electric light.

marked on the map and about 2½ miles from the works. Here a self-starting 40-kw continuous-current converter will probably be placed. In the course of time it will no doubt be necessary to erect more substations, as large loads may be expected in the residential districts of Bickley and Plaistow, whose positions are marked on the map. At the points *BB* on the distributing network is the temporary connecetion to the network of the Beckenham Urban District Council. The feeders are provided with thick fuses on the switchboard, but are connected to the network through lighter ones, and the distributers are interconnected through fuse links at all the crossing points. The link boxes and service boxes are, as the mains, of Callender's make, the boxes being of the usual cast-iron pattern for filling with compound, the cables being led in through pockets likewise filled in with compound. On the Chiselhurst network there are four feeding points at an average distance of about half a mile from the station, the farthest consumer being about one mile from the station. The longest feeder has 0.175 sq. in. copper, and the shortest 0.075 sq. in. The Chiselhurst distributers are also 0.075, 0.05, 0.075 sq. in.

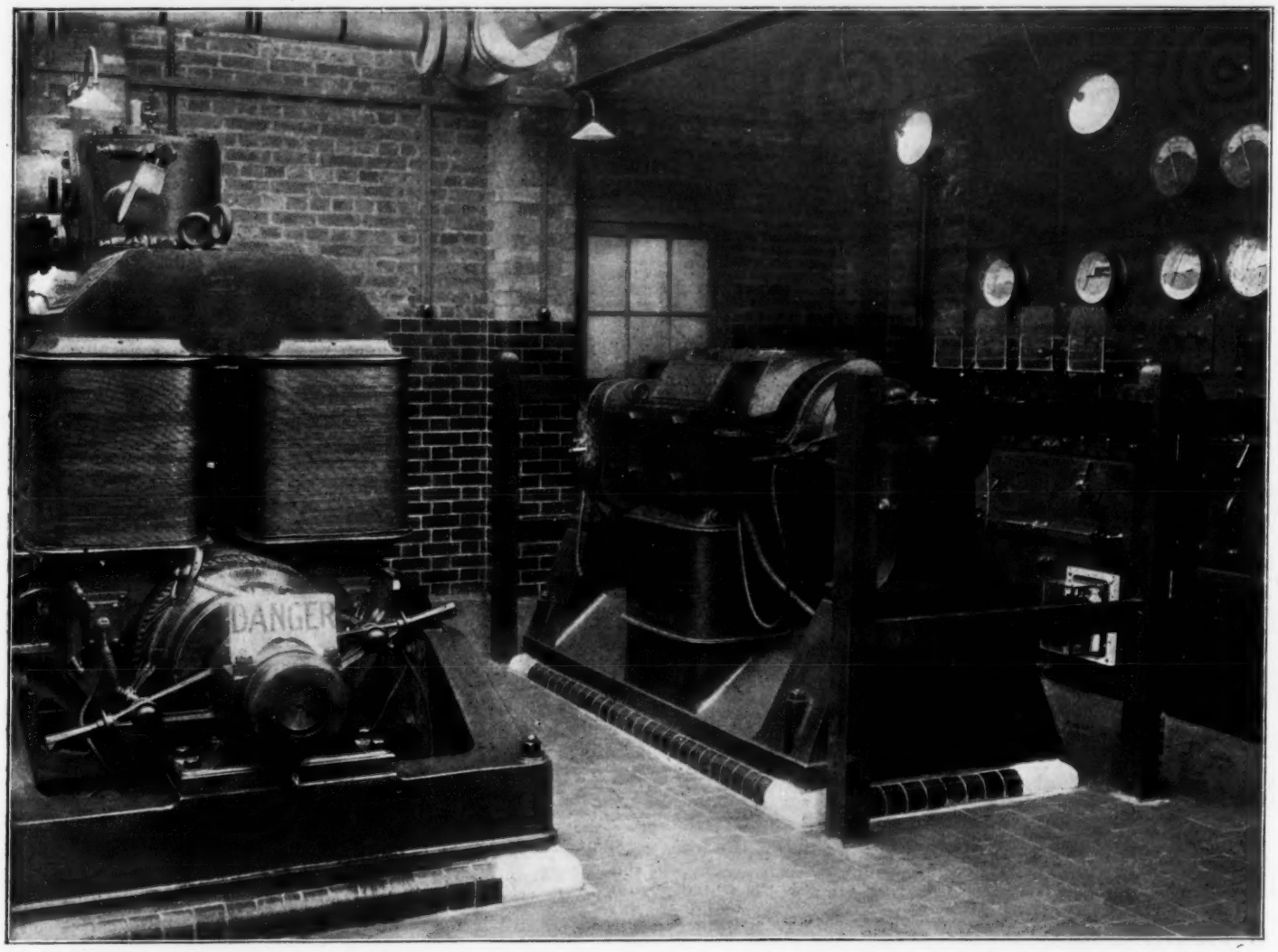


FIG. 5.—BROMLEY HIGH PRESSURE GENERATING PLANT.

The largest and longest low-pressure feeder follows the course of the high-pressure main from Bromley as far as the point *A* on the map at the little village of Widmore, a distance of about 1800 yards. This is of 0.3 sq. in. copper. The other feeders are as follows:

To feeding point	C,	about	1200	yards.....	0.175	sq. in.
Ditto	D,	do.	900	do.	0.15	do.
Ditto	E,	do.	900	do.	0.15	do.
Ditto	F,	do.	100	do.	0.1	do.
Ditto	G,	do.	150	do.	0.1	do.

All the feeders are triple concentric, the neutral wire having, of course, a less section than the others; the distributers are three-core and all of the same size—0.075, 0.05, 0.075 sq. in. copper. Both are armored and laid directly in the ground. There are some 12 miles of distributers, and the distance of the farthest consumer on the Bromley network from the works is slightly over two miles. It is intended shortly to add a substation at Southborough, at the point

The Chiselhurst substation, Fig. 3, has two continuous current transformers, already described, a combined booster and balancer set similar to that at Bromley, a battery of the same size as the Bromley one, and high and low-tension switchboards designed on the same lines as those at the main station. In Fig. 3 one of the two transformers is hidden by the other; the booster and balancer set is on the left, the low-pressure switchbord behind the transformers, and the high-pressure board on the right. A difficulty apparent at Chiselhurst is that there is no provision for filing up the commutator, this part of one of the machines being in a far from healthy condition. Even if the transformer were run at a slow speed by connecting a few cells to the high-pressure side, no doubt sufficient e. m. f. would be generated in the low-pressure armature to cause sparks under the file, so that filing under those conditions might not improve matters. The shafts of the machines should have been extended, as the two transformers are ranged exactly behind one another, so that a pulley

might have been put on each, and thus one be belted to the other for the purpose of turning it to file the commutator. The motor transformers are started from the low-pressure side, and there is no regulating apparatus on the high-pressure side—a telephone to the Bromley works answering more or less the same purpose when alteration of the high-pressure is necessary.

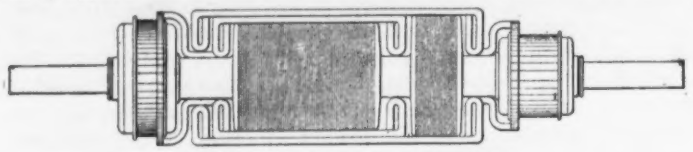


FIG. 6.—ARMATURE OF DYNAMOTOR.

These are 4000 lamps connected at Chiselhurst to the mains as the result of nine months' working. The average efficiency from the high-tension to the low-tension side of the transformers is stated to be as high as 90 per cent. The current is supplied from Bromley, and charged for at the rate of 6 cents per kw-hour at the Chiselhurst end of the high-tension main. The trading for the nine months has resulted in a small profit.

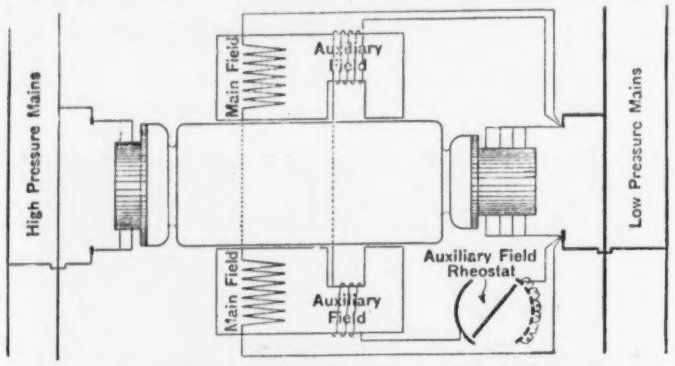


FIG. 7.—DIAGRAM OF ARMATURE CONNECTIONS.

In Bromley there are now connected 7337 8-cp lamps, and about 1000 more are being wired, exclusive of the 4000 connected at Chiselhurst, which are of course supplied from Bromley. A substantial profit has been earned during the year.

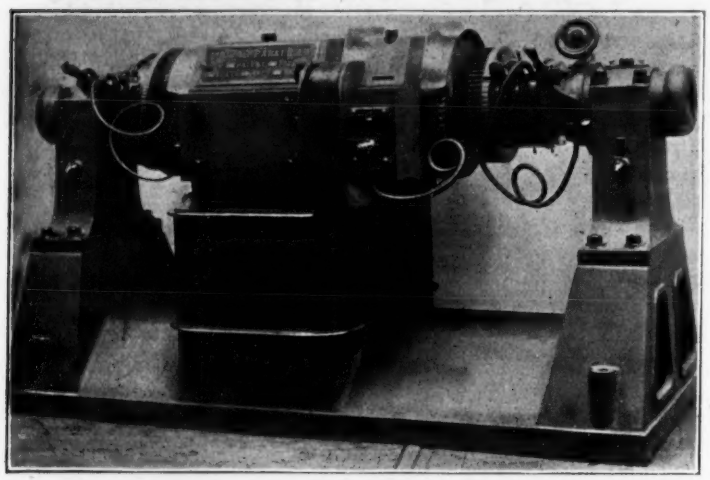


FIG. 8.—DYNAMOTOR.

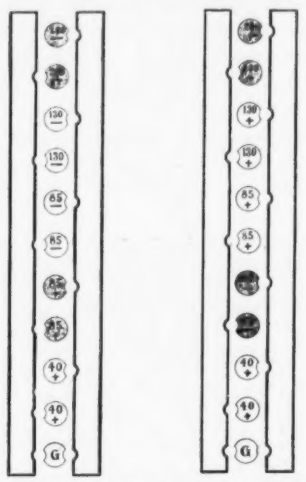
We are indebted to London *Electrician* for the above description of this interesting plant.

A Curious Telegraph Switchboard Phenomenon.

In the main operating room of the Postal Telegraph Company in New York, a curious phenomenon has been observed for which thus far no explanation has been found. Briefly, certain horizontal lines of disks on the great telegraphic switchboard extending along one side of the operating room are uniformly discolored in a very marked manner, and the closest scrutiny has failed to reveal the cause for such discoloration, or why it should be confined to particular rows of disks.

Referring to the accompanying illustrations, the switchboard consists of sections of slate, each containing 25 vertical rows of disks lying between vertical strips. To each strip a telegraph line is connected, and each disk is a terminal on one of the poles of a source of e. m. f.—in this case a dynamotor in the basement of the building. Each vertical row contains eleven disks, thus forming that number of horizontal rows the length of the switchboard. As will be seen by reference to accompanying illustrations, these disks may be connected to the adjacent line strip by means of a plug. Each pole of each voltage is represented by two disks, one of which may be plugged to the adjacent strip on the right and the other to the strip on the left.

The curious circumstance is as follows: In looking at the front of the board, it is observed that one pair of horizontal rows of disks at the top of the board and another pair just below the centre of the board are of a noticeably darker color than the other horizontal rows of disks. This discoloration extends the entire length of the great switchboard, and is due to the accumulation of a thick layer of dust.



FIGS. 1 AND 2.—SHOWING DISCOLORED DISKS.

Fig. 1 represents a vertical row of disks and two strips on the extreme left-hand section of the board. The discolored disks are a pair corresponding to 200-volt positive poles and a pair corresponding to 85-volt negative poles. Fig. 2 represents a similar pair of strips with accompanying disks situated on the extreme right of the board, but in this case the pair of 200-volt *negative* disks and the pair of 85-volt *positive* disks are the ones which are discolored. In each case the disks of same voltage are connected to the same dynamotor. It should be mentioned also that the line strips on the right-hand portion of the board have not yet been connected up, but the disks are "alive"—that is, connected to sources of e. m. f.

A close examination of the rear of the switchboard has failed to indicate any disposition of electrical connections or neighboring wires that would point to a greater probable effect on the discolored than on the other disks of the board.

We shall be glad to receive any explanation our readers may offer as to the probable cause of the collection of dust on the disks, and as to why it should collect on the particular rows affected.

Electrical Transmission to Venice.

It is proposed to utilize the River Cellina and part of the River Piave, in Italy, for the generation of electric power for transmission to Venice. According to a memorandum from one of the engineers interested in the project, the Cellina is able to supply Venice with electrical power equivalent to 10,000-hp at a distance of 59 miles. The government is ready to grant the concession and the work can be begun immediately. The Piave offers more favorable conditions. The falls in this system would be two, with a combined height of 738 feet. It would be possible to include a third fall 229.6 feet high. From the two falls of 738 feet to Venice, 43 miles distant, 27,000-hp can be conducted. By making use of the third fall, this figure could be increased by 8400-hp. Application has been made for a government concession, but the concession cannot be obtained for at least a year. A private company has been formed to carry on operations on both of these rivers and is now negotiating with various banking houses for the necessary capital. The names of the prime movers in the enterprise are as follows: Counts N. and A. Papadopoli, Venice; Commendatore Giuseppe Da Zara, Padua; engineers, Ernesto Breda, Milani, and Colle, care of the above. English capitalists have sent a representative to Venice to arrange for the co-operation of English promoters of similar enterprises.

An Electrical Engraving Process.

BY N. S. AMSTUTZ.

THE mechanism to which this article relates is the outgrowth of my investigations in the field of photo-telegraphy which were commenced as early as the year 1885. These researches were the outgrowth of extended experiments with the telephone and phonograph in connection with photography. Exhaustive laboratory experiments were very successful in transmitting through a considerable distance photo-messages and receiving them in the shape of engraved records. The fundamental principle of the system consisted in producing a variation in an electric circuit corresponding to the

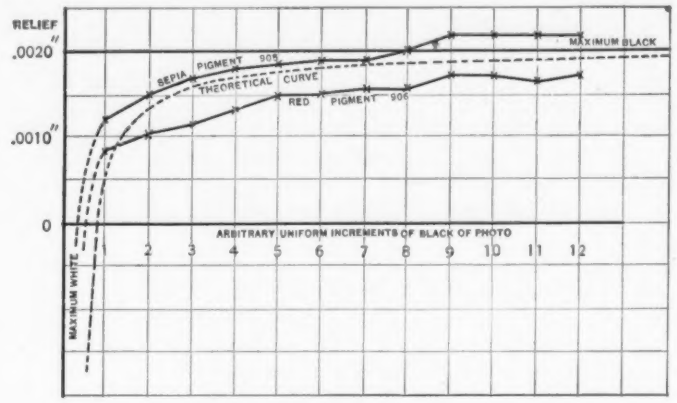


FIG. 1.—GRAPHIC CURVES.

variations of the lights and shades of a photograph. This utilized a current in some aspects similar to that representing the modulation of the human voice in the telephone.

It is of course well known in telephone practice that a telephone circuit has impressed upon it the effects of the voice through the transmitter diaphragm, not as a series of uniformly shaped waves, but as a series of continually varying waves that vary in their amplitude, their number in unit time and their specific shape; the amplitude change representing the increase or decrease of volume, at a given uniform pitch; the change in number representing a high or a low position on the musical scale, and the change in shape representing the individuality of the source of the waves.

In my photographic researches relating to their telegraphic trans-

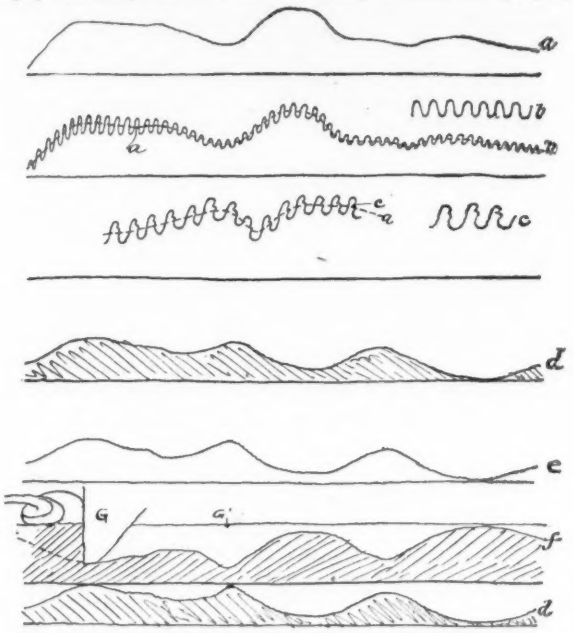


FIG. 2.—PHOTO RELIEF AND VOICE CURVES.

mission I used what is commonly known as a "carbon" photo, which simply consists of pigmented gelatine sensitized in bichromate of potash, printed either by sunlight or the electric arc light and thereafter washed in hot water, which removes the unacted gelatine and leaving a relief surface that varies in height or thickness with the light and shade of the photo negative from which it is printed. This variation, as may be seen from the graphic curve shown in Fig. 1, is nearly directly proportional to the intensity of the light action.

In Fig. 2 is shown the similarity between a photo-relief curve and one representing the modulations of the human voice. In this figure *a* represents the curve of voice modulation, *b* the curve of voice pitch and *c* the curve of individuality. The relief curve of a photographic subject is represented by *d*; *e* represents the curve of illumination necessary to produce the photo relief, and *f* represents an engraved line curve made from *d*.

The objections to a variable current form of photo-transmission are found in the necessity of having the exclusive use of the line during the time of transmission, and in the fact that the variable current is very susceptible to line changes, thus modifying the engraved result at the receiver to a marked degree and causing zones of variation, in tint, independent of the photographic variation at the sending end.

It was to overcome these difficulties that the acrograph was primarily designed. Its very first conception was, however, closely related to accident—accident which, on account of the alertness due to the close study of the recording problems encountered in the transmission work referred to, was just enough to remove the discovery from the purely accidental. The discovery was made while trying to avoid the use of a variable current by substituting some method of breaking up the half-tone of the photo into arbitrary picture points so as to be able to use only "dots and dashes" in the transmission.

The half-tones of the photo were broken up into picture points on a copper sheet by making an insulating enamel print through a

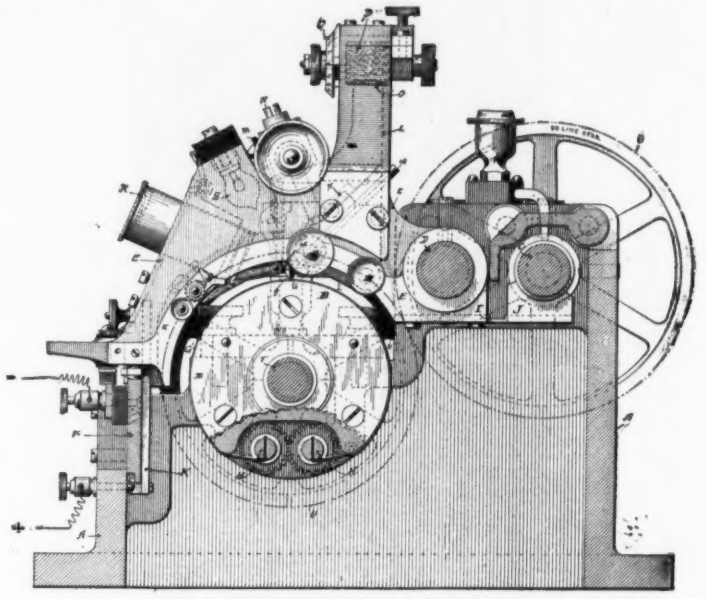


FIG. 3.—CROSS-SECTION OF APPARATUS.

"screen" as though it was to be acid etched for regular printing press purposes; but this was not practicable for transmission on account of the difficulty of making the number of lines of the subject conform to the pitch of the transmitter carriage feed, and the further difficulty of making the edge of the sending plate to lie parallel with the lines of the subject. If all of these conditions were not conformed to, then the result at the receiving end was anything but satisfactory on account of interference effects produced when the subject and the sending apparatus were out of register. This could in a measure be avoided by making the subject abnormally large and the pitch of the sending carriage relatively fine, but there would yet remain the serious deterioration of the transmitting platinum point on account of the breaking of the current as it passed from off the enamel insulating lines. The mechanical wearing away of this point is just as serious a matter as the other.

My researches enabled me to discard the camera in making the enamel prints on the copper sheets and avoided all the difficulties except the last two referred to. This was accomplished by dispensing with the cross line effects and using instead single parallel lines to break up the half-tones of the photo. The method of procedure follows: A series of single parallel lines was ruled on a transparent sheet of pyralin, and the grooves were filled in with a black pigment. This sheet was then placed over another transparent sheet, without lines, of 0.10 inch thickness, and this in turn was placed over the sensitized surface of the copper sheet, the whole being placed into an ordinary photo printing frame. By this method it was not necessary to use a camera. The metallic sheet

was washed in warm water and the remaining enamel was burned on by heating over a gas flame. The photo metal sheet was then mounted on a drum, the lines parallel with the axis.

By this simple means all the difficulties of "register" were entirely avoided, as it made little or no difference whether the path of travel of the transmitting tracer was at right angles or not, to the lines of the photo, so long as this direction was approximately at right angles thereto.

The deterioration of the tracing point was still existent and to avoid this I engraved the lines into the copper sheet by ordinary acid etching so as to form a series of parallel grooves, and then caused a tracer attached to a pivoted arm to ride up and down over the grooves and the intervening ridges so that when it was on the top of a ridge the other end of the arm closed the line circuit or vice versa. This form of a device eliminated the deterioration of the tracing point, as there was no longer any current of electricity active through the same; neither was the mechanical wearing away of the platinum encountered, as a sapphire or diamond point remained practically unaffected.

The receiving for all of these sending systems was done in the shape of an engraving on a sheet of pyralin or celluloid, or on a metallic plate coated with chalk, similar to the well-known newspaper "chalk" engraving plate, from which a stereotype casting was then made for printing; or the result was received on a transparent material coated with an opaque substance which the receiving stylus scraped away according to the direction of the transmitter.

This last form of a received record was then placed in a photo printing frame and a print was made upon a sheet of zinc or copper and etched in the ordinary manner—the negative being prepared on the receiving machine instead of the camera and dark room of ordinary photo engraving practice. The reader will pardon this short digression as it is so closely connected with the inception of the acrograph that its omission would deprive the reader of some very interesting corelated researches.

FIG. 4.—SPECIMEN PORTRAIT.

While ruling the "screen" sheets referred to it was an occasion of great surprise to see one of the ruled sheets show a sinuous line across the ruled lines. Upon close inspection of the effect it was noticed that the V-cutter used in doing the ruling had at this point made a wider cut than at any other place, and it was the combined effect of these wider cuts that made the sinuous record so noticeable. Then came the search for the cause, which was not far to seek, as a camel's hair brush had been used to clean the drum upon which the sheet was stretched for ruling, and a single hair had lodged upon the drum under the place where the sinuous record was formed. It was but a moment to reason from the record of a single line of thickness—the camel's hair—to a variable surface of about the same dimension of thickness in the shape of a relief photo, and place the same under another sheet of pyralin and see what the effect would be when the cutter traversed over it.

In this hurried trial, fortunately, the angle of the cutter bore a close relation to the maximum variation of the photo relief and the number of lines per inch that were ruled, as otherwise the effect would not have been so startling; but as it was, the effect was phenomenal, as the moment the sheet was removed from the drum there appeared a clearly defined engraved image of the photograph, having the lights and shades faithfully interpreted, being full of accurate detail and withal a most astonishing result. This then at once became a matrix for use in telegraphic work, similar to the acid etched copper sheet referred to, thus avoiding the necessity of the acid etching with the element of uncertainty due to the acid action avoided and instead, the mechanical certainty of the fixed tool angle and the positive relief of the photograph, substituted.

One might have expected some remote resemblance to the original in the first reproduction, but to have anticipated the startling results with their richness of detail, etc., was quite improbable. The machine upon which the ruling was done was one of the early telegraphic machines improvised into a ruling machine, having no adequate means of micrometrically adjusting the cutter, etc., so that the first result was still a long ways from certainty of accurate duplication when the cutter should be changed for resharpening, etc.; and the relation of the number of lines in connection with the amount of the photo relief to determine the cutter angles was not yet anticipated. From the brief experience with the extemporized machine, designs were made for a working machine that should be provided with micrometric adjustments, etc. This is the only machine that has been built and it is the one upon which the specimen engravings shown were made. It also represents the outgrowth of adaptations, unanticipated at the time of the discovery, but which since then have developed to greater relative importance than the first uses to which the principle was intended to be applied—preparing photo matrices for telegraphic transmission.

This then was the discovery of the acrograph. The name to designate the invention was selected from two Greek words, akros, at the top, and graphé, to grave or write—literally meaning top cutting as the cutting sheet is placed on top of the photograph which is to be reproduced. A cutting tool similar to that used by wood engravers is used, hence the designation, top-cutting or top-graving is as near a literal interpretation as is possible.

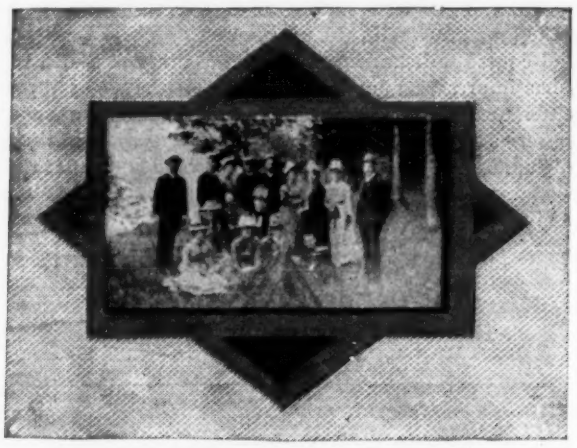


FIG. 5.—CROSS LINE ENGRAVING FROM 150-LINE ACROGRAPH.

For the purely telegraphic adaptation the transmitting machine would have the acrographic feature of cutter and the proper adjustments therefore, made a part of itself so as to avoid the necessity of a separate machine to prepare the photo-matrix for transmission. These engraved photos are serviceable for transmission as many times as it may be necessary to use them. Just in passing it may be said that the accuracy of synchronizing, which is entirely satisfactory for transmitting outline sketches, is wholly unsuited for the transmission of photographs. Recent experiments prove that rectifying impulses once in each revolution of the drum, or even four per revolution, are altogether unsuited for the close timing necessary in this work; even as many as 180 corrections per revolution leave much to be desired in the way of absolute accuracy.

All of the telegraphic adaptations have, however, been held in abeyance pending the completion of the acrograph system as applied to the illustrative arts in general, and to this end a very accurate grinding machine has been designed and built for the rapid production of the cutting tools, in steel, sapphire and diamond, the two latter kind being used so as to avoid resharpening operations that are inseparably connected with the use of steel tools. If the cutting was not done at a greater speed, in feet per minute,

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than is used in ordinary wood engraving ruling machines, then the steel would be sufficiently hard to stand the work imposed upon it; but at the speeds used on the acrograph, running from 100 to 130 feet per minute, the steel requires resharpening after about 1500 to 2000 feet of cutting.

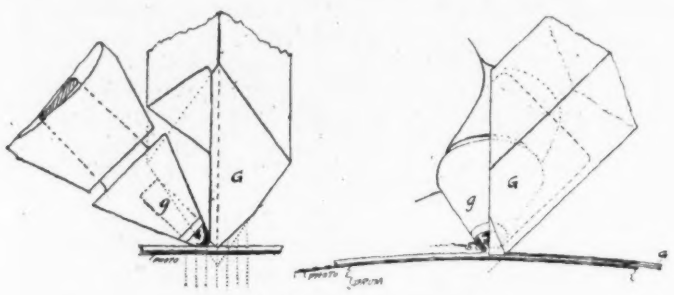
A photo 4x5″ at 150 lines per inch would contain 250 feet; that is, if all the 600 lines of such an engraving were placed end to end there would be 250 feet of continuous line.

The elapsed time required to engrave a photograph of the size 2⅛x2⅞″, shown in Fig. 4, when the machine drum, 3⅜″ diameter, is making 140 r. p. m. and is cutting 180 lines per inch, is $t = \frac{PW}{R}$ where t is the time, P is the pitch or number of lines per inch, W is the width in inches and R is the r. p. m.; hence t, in the case given will be $\frac{180 \times 2\frac{1}{8}}{140} = 2.73$ minutes.

The elapsed time, as given in the preceding formula, is not the actual time of cutting, as the specimen shown in Fig. 4 only occupied 2⅞″ of the 10.06″ comprising the circumference of the drum; thus only 27.1 per cent. of each revolution was used in performing work, so that the actual cutting time was reduced in the same proportion, thereby bringing it down to practically ¾ minute. From this it will be seen that a drum of 3⅜″ diameter does not work at a high speed efficiency when using such a small sized subject. The drum will accommodate a subject 8x12″.

Even when only 27.1 per cent. of each revolution is available for work with subjects of the size referred to the elapsed time of 2.73 minutes is so small that the great loss of 72.9 per cent. of each revolution is negligible. It should be understood that an engraving 2⅛x8″ would have been executed in the same time as was Fig. 4.

At the coarser pitch of 120 lines to an inch it will be seen that the speed will be very much increased. Coarser work, such as is used in newspaper printing, running about 80 lines per inch, would require less time, and at this pitch a photograph 8x10″ would require 6 minutes to be transformed into an engraving, at 107 r. p. m.



FIGS. 6 AND 7.—THE CUTTER.

The cross sectional end elevation shown in Fig. 3 discloses the constructional features of the apparatus, from which it will be seen that the device is a specially designed lathe.

A solid frame, *A*, is provided, upon which the drum, *B*, turns in self-aligning bearings. A feed screw, *C*, also has bearings in the frame at its rear side. There are two riding bars upon which the tool-holding carriage, *E*, travels. One of the riding bars, *D*, is located between the drum and the feed screw, the other riding bar, *F*, being placed in front of the drum.

When it is remembered that a V-tool, *G*, is used it will at once be apparent that the machine is practically a screw cutting lathe, cutting discontinuous threads in a sheet of pyralin, celluloid, gelatine or sheet metal, that is stretched around the drum. If there was no change in the depth of the tool while it was cutting, and in the position of the sheet upon which the V grooves were being cut, then there would simply be formed a series of parallel grooves with intervening ridges—threads—all of uniform depth and width.

If the tool was moved to a greater or less depth during any part of a single revolution, then at such point the groove would be deeper and wider if the tool was moved deeper into the sheet, and the adjoining ridge would be correspondingly reduced in cross section; on the other hand, if the tool was raised slightly, then the groove would be shallower and narrower while the ridge or "thread" adjoining would have a larger cross section.

A sheet ruled with parallel lines, or rather with parallel V-grooves of uniform depth and width, and of such a depth that the contiguous grooves should just meet at the face of the sheet, would represent a series of sharp V-threads of whatever pitch the change gears had predetermined. If instead of this maximum depth the tool was set down so that contiguous grooves would not quite meet on the face of the sheet, then the intervening ridges would represent a United States standard thread. This analogy would only hold with respect to the ridges or threads proper, but not to the cross section of the grooves, as they remain sharp V's in all cases, the cross section being the same at all times as that of the cutter, which is of necessity kept as sharp as possible so that there shall be no loss of detail in the engraving.

If the sheet having the sharp V-threads formed thereon were subjected to an ink roller, the ink would only touch the very sharp points of the threads and obviously would not have any medium to come into contact with the ink roller at the grooves. Hence when a sheet of paper is placed on the engraved surface and then subjected to pressure, as in a printing press, the ink on the "threads" is transferred to the paper, thereby giving a graphic record of the performance of the cutting tool.

A similar proof of the flattened threaded sheet would disclose wider black lines than those of the previous proof and narrower white spaces between them where the first proof had wider white lines and narrower black ones. If the tool was arbitrarily moved deeper from .001″ to .0025″ at fixed points during each revolution a conventional design could be produced on the sheet, wholly due to the fact that there was a variation in the cross section of the grooves inversely to that of the ridges.

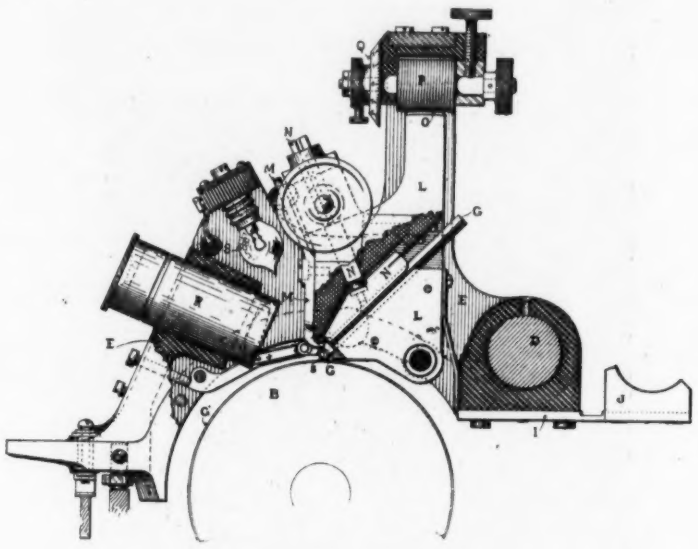


FIG. 8.—DETAILS OF THE TOOL.

One of the first mechanisms made by myself, when commencing my investigations with relief photography and telegraphy, comprised a simple drum, a relief photo, and above the photo at one end of the drum a delicate tracer. This tracer was connected to an arm that was fastened to a pivoted shaft placed parallel to the drum, having at its other end another arm supporting a V-shaped cutting tool. The cutting tool was above the drum at the end opposite to and some distance from the photo. A sheet of recording material was placed under it and the tracer adjusted so as to delicately bear on the photo. Then when the drum was moved the tracer would rise and fall over the surface and cause the cutter to do likewise, thus reproducing the photo.

In this form of device I soon found that the mechanical work necessary to do the recording, in the shape of an engraving, required so much effort that the photo was indented and the accuracy of the relief surface was destroyed. In the acrograph system the delicate tracing point is at the same time the recording or cutting point.

As seen in Fig. 3, the recording sheet, *G'*, is secured on the drum, *B*, by means of two intergeared tightening rods, *H*, that are provided with slots into which the ends of the sheet are placed; then the rods are turned and are kept from unwinding by a pawl which engages one of the gear wheels. The photo has, of course, been placed thereunder at the desired location of the sheet.

The tool-holding carriage, *E*, which is, in its functions, analogous to the slide rest of a lathe, rides upon the round bar, *D*, located between the drum, *B*, and the feed screw, *C*. It can be raised and lowered into position by swinging upon this bar as a pivot. To the

rearward of this riding bar there is a spring projection, *I*, from the carriage, which supports the half nut, *J*, engaging the under side of the feed screw, *C*. As the feed screw is rotated the carriage is moved laterally, parallel with the axis of the drum. In front of the middle riding bar, *D*, the carriage drops downward concentrically with the drum, *B*, and terminates in a projection, *e*, resting upon the forward riding bar, *F*, where it is removably fastened to a slide, *K*, upon this bar, which precedes the carriage in its lateral travel. The slide places just enough tension upon the carriage to cause the feed screw to work upon one side of its V-thread only, thereby avoiding back-lash and irregularity in the ruling. The feed screw is cut with sharp V-threads, 48 per inch.

The carriage is slotted vertically, and in this slot is placed a pivoted tool holder, *L*. This tool holder has a forward limit stop, *M*, for the tool; a clamping device, *N*, for holding the tool in place, and at its rear upper end a toothed segment, *O*, is formed; this latter meshes with a micrometer screw, *P*, of 40 P. The screw carries an adjustable dial, *Q*, which is graduated to read so that an arc of .353″ represents .001″ of movement at the point of the tool, and an arc of .0353″ of the dial rim represents, in direct reading, a tool point movement of only .0001″. A vernier splits this up into ten parts, but this last refinement is out of the realm of ordinary practical mechanics, and in machines for the market will be omitted.

FIG. 9.—ENGRAVING FROM A 120-LINE ACROGRAPH.

I have found that the delicacy afforded by the one ten-thousandth of an inch is quite sufficient for the finest work, and this delicacy does not go beyond the reach of standard mechanical practice.

In order that the tool may be easily adjusted to the proper position a microscope, *R*, is placed within access of the operator and to the rear of this is placed a 2-cp electric lamp, *S*. By means of this lamp and the microscope the cutter may be inspected as it progresses in its work, and by these means the tool is adjusted to the highest portion of the photo, easily and quickly. A few seconds are sufficient to bring the micrometer dial around to "o" and then adjust the tool down the same distance the photo is in relief.

The drum shaft, *T*, and the feed screw, *C*, are interconnected with removable gears, *U*. The driving is done from the drum shaft by a 1-12-hp Edison battery motor at an e. m. f. of 8 volts. The demand for current when the acrograph is running at 150 r. p. m. is 5 amperes. The net demand for energy to drive the acrograph machine alone is but 10 watts. The removable gears, *U*, connecting the drum shaft and the feed screw determine the number of lines per inch, or what would be known as the "pitch" in screw cutting.

The portrait in Fig. 4 has but 180 lines per inch, and the following data relates to the cutter form necessary to produce the same. Let *L* represent the lines per inch, *R* the maximum relief of the photo, *C* one-half of the cutting angle and θ the whole cutting angle; then tan *C* = the reciprocal of $P \times 2 \times R$ and $\theta = 2C$. The values are, for *L*, 180, and for *R*, .0014, from which $\tan C = \frac{1}{180 \times 2 \times .0014''} =$ 1.985. or *C* is 63° 15′ and $\theta = 2C$ or 126° 30′.

There is placed alongside of the cutter, *G*, a guide point, *g*, as shown in Fig. 6, which presses the recording sheet firmly against the photo relief and relieves the cutter from doing this, as well as cutting the grooves. In very coarse work the guide point is not absolutely needed, for, paradoxically as it may seem, the cutter can be so shaped that it will of its own accord push the recording material away from in front of itself into a hollow of the relief surface when a less depth is to be cut. This result can be obtained in the finer grades of work as well, but it is deemed expedient to relieve the cutter of all of the directive work and concentrate this function in the guide point, which is placed on the "leading" side of the cutter advancing lengthwise of the drum. Fig. 7 shows a side elevation of Fig. 6. In Fig. 8 is shown the tool holder in detail.

An engraving not here shown was made directly from the watermark in a piece of paper at 284 lines per inch. This is an evidence of the marvelous sensitiveness of the machine. In order that the drum may be accurate enough to make possible these results, it is carefully ground while running in its own bearings, by a special grinding carriage running on the same ways, upon which the regular cutter carriage slides. The forward riding bar is adjustable at its ends so as to facilitate the manufacture of the machine, as by this means the cutter point can be brought to travel absolutely parallel with the drum surface in a few moments. When this is attained the riding bar is locked in position against being tampered with by unauthorized persons. Fig. 9 shows a yacht engraved at 120 lines per inch, vertically.

The small electric lamp shown in Fig. 8 receives current from the accumulators which supply the motor, through an insulated plate secured to the forward riding bar, upon which a contact spring of the carriage rests. In circuit with the lamp is a small rheostat to protect the lamp against excessive voltage when the accumulators are newly charged.

In practice, acrograph engravings may be quickly cemented to wood blocks, nearly "type high," from which prints may be made, or the engravings may be electrotyped from in the ordinary manner. Most beautiful artistic effects in the shape of unalterable art transparencies, embossing dies, art tile dies and accurate photo-water mark dies are quickly produced by discarding the V-shaped tool for a round ended one. This form of tool cuts away all the ridges between contiguous paths of travel that would not be removed if a V-shaped tool was used. This form of a reproduction is now serviceable for press printing.

The time necessary for producing the carbon photo reliefs is about three-quarters of an hour, so that the time used in getting ready for the engraving work is not long. The photo is not injured at all and may be reused as many times as is desired.

The reader will have noticed a marked similarity between the phonograph and the acrograph. In fact the acrograph does for light what the phonograph does for sound.

Telephone Conversation Recorder.

According to a Paris cablegram the French government is considering the use of a "Compteur telephonique" for the purpose of limiting conversations to three minutes exactly. At the expiration of that time connection is cut off, but it may be re-established by pressing a button. It is thought that this system will increase the number of subscribers, and that the telephone will be used much more if this new system is inaugurated. Then the tariff will be 40f. ($8) a year subscription fee, and the price of the telephone apparatus installed in each house 120f. ($24). The last-named sum may be paid in instalments of 60f. ($12), 40f. ($8) and 20f. ($4). Then to this is added the regulation 15c. per three minutes' conversation, as shown by the compteur, so that an outlay of 160f. ($32) for the first year, plus the actual work done, represents the cost of telephoning, should the new system come into vogue.

Manufacturer's Trip to Paris.

The National Association of Manufacturers of the United States has made arrangements for a trip to the Paris Exposition for such of its members as may desire to avail themselves of the opportunity offered. The trip will be made under the most favorable conditions and at reasonable cost. The party will probably sail on the steamer St. Louis on June 13.

Fire Alarm and Police Telegraph System, Los Angeles.

THE City of Los Angeles, Cal., recently installed one of the most complete automatic fire alarm and police telegraph central offices in existence. It comprises an equipment for fourteen box circuits and ten gong circuits for the fire alarm system, and four signal circuits for the police telegraph system. This central office is located in the city hall in suitable quarters on the first floor, and the battery room is located in the basement immediately underneath, making altogether a very convenient and desirable arrangement for the officials in charge of the system. The switchboards are arranged on each side of the central office room, being set away from the wall a sufficient distance to admit of easy access behind them, and are enclosed in handsome quarter-sawed oak framework. There are two automatic eight-circuit repeaters, with ten-gong circuit attachment, of the Gamewell manufacture, which are arranged and connected up in tandem in the centre of the room between the switchboards. These tery board, composed of two adjoining sections, each arranged for twelve circuits, making twenty-four circuits in all. These boards are of slate, well filled with paraffine so as not to absorb moisture, and they combine charging rheostat, with suitable lamp resistance, and discharging rheostats for the lines. Each circuit is provided with a milliamperemeter which is in circuit at all times, and shows at a glance the exact current running on the line. Each section of twelve circuits of the storage boards for the fire alarm system is provided with a standard Weston ammeter and voltmeter, which are cut in by a plug and the spring jacks at each circuit, as shown. The insertion of this plug cuts in both instruments at once, and gives a positive reading of the conditions of the circuit; and as there are spring jacks on the charging side for each circuit, and also on the discharging side of each circuit, all conditions may be taken. Each section is also provided with neutral and polar relays, for the purpose of controlling the charging circuit into the batteries, so that in the event that the charging circuit should become reversed, or current should cease to flow

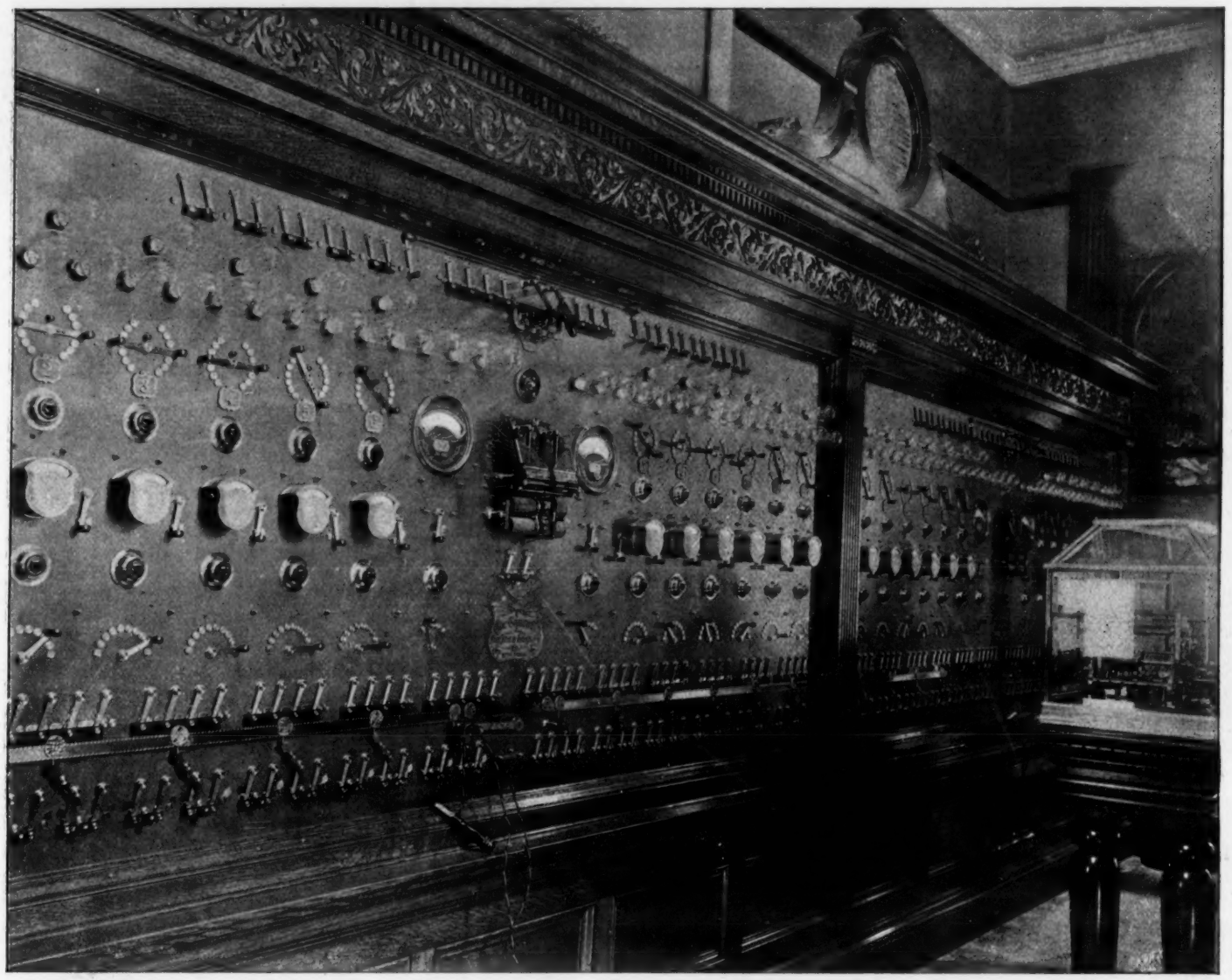


FIG. 1.—FIRE ALARM STORAGE BATTERY SWITCHBOARD.

are mounted on handsome tables of quarter-sawed oak, having hollow legs for the wires to pass up through to the apparatus.

The battery room, which is located in the basement, is of most convenient arrangement. There are grouped on shelving some 900 cells of storage battery, laid off in circuits as required. The framework that supports the battery jars is also of quarter-sawed oak and firmly braced with galvanized iron rods at the top, the base of the framework being mortised into a concrete floor, the whole making a very substantial arrangement. The batteries are arranged, for each circuit, in two banks designated *A* and *B*, the *A* side being on one side of the stand and the *B* bank on the other, and all being appropriately numbered. The battery room is well ventilated and lighted, and is a most excellent location, being cool in summer, which is a very desirable condition, inasmuch as the evaporation is reduced thereby to a minimum.

Referring to the cuts, Fig. 1 is a view of the fire alarm storage bat- from it, or the circuit should become broken in the batteries, it will be automatically disconnected, through the medium of the polar and neutral relays in combination with an automatic circuit breaker, shown at the top and middle of the board section. This breaker comprises in addition a manual knife-switch arrangement that may be also operated by hand. There is arranged at the top of each section of the charging board, a series of lever switches, for the purpose of combining the batteries for series or multiple charging, as may be desired. At the bottom of the board is provided a gang-switch with a rotating crank-lever, arranged to change the *"A"* bank of batteries from the discharging side to the charging side, placing the *"B"* batteries on the discharging side, or vice versa, as the case may be, by one movement of the crank. By this method of operation all the bat teries are changing at the same moment, without causing any interruption in the firm alarm service. The arrows attached to the gang-bar indicate the banks of batteries that are being charged.

All of the fire alarm circuits are treated alike, each having its proportion of batteries necessary to furnish the current required on the line. These two sections combined cover a space of about 22 feet along the wall. The height to the top of the ornamental framework is about 9 feet. The ornamental piece in the centre is a handsome phosphor bronze plate inscribed with the names of the mayor, councilmen, fire commissioners, chief engineer and city electrician, and the date of installation.

Fig. 2 shows the arrangement on the opposite side of the room. The larger of the two boards is a twenty-four-circuit working board for the fire alarm system, comprising automatic circuit breakers and fuses, ground-test switches and a series of spring jacks with two sets of gang switches with crank levers arranged for throwing same. There is also provided on this board a centre zero-reading voltmeter for ground tests, which is operated by the lever switches shown at the middle of the board, all mounted on slate base in the same manner as the charging boards. The gang switches are for the purpose of controlling the two repeaters shown in the centre of the room. By the operation of these gang switches, the entire fire alarm system may be thrown on either repeater, or divided as may be required, making a very convenient arrangement for those that are operating the system. The four-circuit switchboard forming the second section on this side of the room is for the police system. It comprises the charging and the discharging side of each police circuit, and has its own polar and neutral relay, circuit breaker and combining switches, amperemeters and voltmeters, spring jacks, etc., similar to those on the fire alarm board, all mounted on a slate base. Both of these sections are enclosed in quarter-sawed oak framework, which is set away from the wall, as are the sections on the other side of the room.

FIG. 2.—FIRE ALARM AND POLICE SWITCHBOARD.

Fig. 3 represents one end of the battery rack in the basement, showing the arrangement of the batteries on each side of the upright frame. All wiring in the battery room is in cables that are thoroughly wrapped with tape so as to insure the best of insulation. The arrangement of the sections is such that free passage is admitted between the sections and all batteries are approachable from either side. The shelving strips that the battery jars sit on are thoroughly insulated and saturated with insulating compound. The battery room presents a very neat appearance, and the labor of maintenance is reduced to a minimum.

All the wiring in this installation is concealed work of the most substantial design, and is handsomely executed. The central office room presents an exceedingly businesslike and neat appearance, and is lighted with two "baby" enclosed arc lamps, which give ample light for the attendants. The city electrician, Mr. Ira J. Francis, who installed and has charge of this system, also has his office in these quarters, where the switchboard is constantly under his eye. This installation is only a part of these excellent systems of fire alarm and police telegraph, equipped with the latest apparatus that is manufactured by the Gamewell Fire Alarm Telegraph Company. The completeness and efficiency of the entire plant make it a great credit to all concerned in its installation and operation.

The management is thoroughly up-to-date, the city government some months ago having organized the Department of Electricity, with Mr. Ira J. Francis, the city electrician, at its head. The batteries are of the 3B type made by the Electric Storage Battery Company, and the switchboards and central office machinery, of handsome workmanship and design, manufactured by the Gamewell Fire

FIG. 3.—SECTION OF STORAGE BATTERY EQUIPMENT.

Alarm Telegraph Company, were installed under the instructions of their Pacific coast agent, Mr. A. J. Coffee, of San Francisco, to whom we are indebted for many courtesies in the preparation of this article.

American Types of Automobiles.—VIII.

THE CHAPMAN ELECTRIC AUTOMOBILE.

By W. H. Chapman.

IN driving four-wheeled vehicles on the road by any mechanical motive power it is necessary to adopt one or the other of two plans—either two motors connected independently to two driving wheels or else one motor connected to two driving wheels through the medium of a differential gear which, while driving the wheels with equal power forwards as backwards, will also allow the two driving wheels to be independent of each other and take different speeds when going around curves.

A series of experiments were made on both of these methods, using electric motors and storage batteries as the driving power.

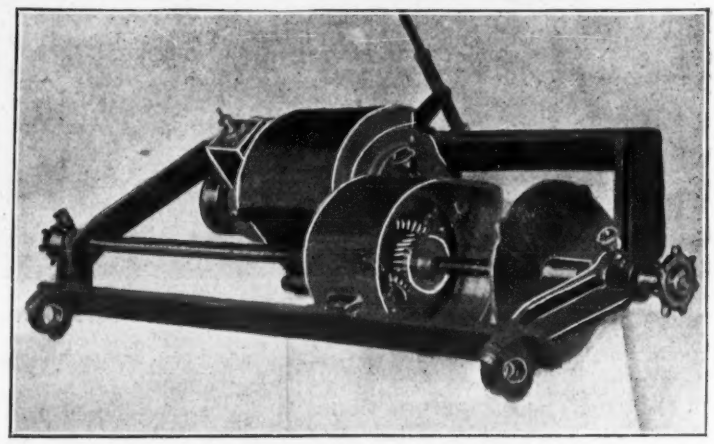


FIG. 1.—MOTOR WITH GEAR CASE OPEN.

Early in August last a 400-pound vehicle was put on the road and the writer has been using it continually since that time for the purpose of studying the conditions prevailing in practice and demonstrating what can be done with different arrangements of the mechanism. His observations have led him to the single motor outfit as being the simplest and most efficient arrangement; and since electric motors of light weight involve quick speeds he also found it expedient to place the differential gear in a portion of the driving

mechanism which has a quick speed. In this way the differential gear may be made many times lighter in weight for the same power than it would be if placed on the wheel axle.

In the earlier experiments two motors of ½-hp each were used on the vehicle, and were geared independently to the two rear wheels. In the single motor outfit herewith illustrated, which proved far better, the rear wheels each have a large sprocket of 30 teeth driven by sprocket chains from 8-tooth sprockets mounted on an intermediate shaft containing at its middle portion a very simple differential gear. The intermediate shaft is composed of two separate parts which, with their sprockets and the differential gear and the motor, are all mounted in a frame which, as a whole, is easily attachable to or removable from the vehicle.

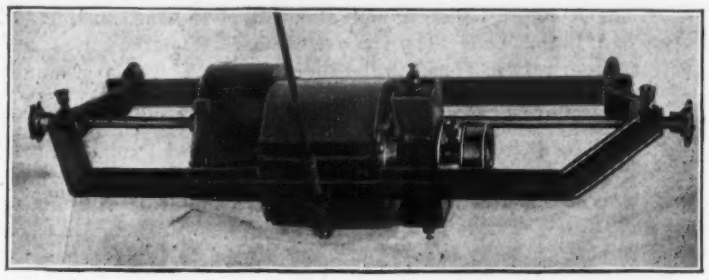


FIG. 2.—MOTOR WITH GEAR CASE.

One side of the frame is pivoted to one of the cross tubes of the vehicle frame and the other side is supported by compressed springs like a car motor suspension. A pinion on the motor shaft having 12 teeth engages with a gear of 72 teeth mounted loosely on the intermediate shaft. This gear has two small mitre gears loosely attached to it, which engage with two mitre gears keyed to the two separate parts of the shaft, the whole constituting a very simple differential gear. Normally the mitre gears do not run on each other except when they are called upon to make up the difference in speed of the two parts of the intermediate shaft in rounding a curve. The gears are all enclosed in one oil-tight case and the lower side of the larger gear is continually bathed in lard oil.

The motor has wrought iron magnets and toothed armature and is completely encased, waterproof and dustproof. It is series-wound, and the windings are of such low resistance that the vehicle may be run economically at a low speed with only four cells of storage battery in series, while at the normal speed 16 cells are in a series. There are two field magnet coils which may be placed in multiple or in series with each other. There are also two sets of storage battery cells, eight cells in a set, which may be placed in multiple or in series with each other.

Three speeds forward are obtained in the following manner: On the first notch of the controller the two coils of the field are in series with each other and the two sets of cells in multiple with each other. On the second notch the two coils are in multiple and the two sets of cells also in multiple. On the third notch the two coils are in multiple and the two sets of cells in series. When the controller is set at one notch back of the off position, the motor acts as a generator and is connected to a resistance which constitutes an excellent coasting brake and keeps an even speed down the steepest grades. On the second notch back the motor is reversed and gives the same speed backward as on the first notch forward.

On vehicles which are to be used in sections of the country where long hills are prevalent, the windings of the magnets are somewhat modified so as to generate back into the batteries when going down hill instead of generating through a dead resistance. This is very easily and simply accomplished in the following manner. Each coil of the motor is wound with four strands of a wire one-quarter as large. On all the forward notches of the controller these four strands are connected in multiple as one wire, but on the first notch back they are all in series with each other and connected as a shunt to the armature, while the two sets of cells are in multiple with each other and with the motor. On all of the forward notches therefore it is a series-wound motor, while on the first notch back it is a shunt-wound motor adapted to charging the batteries and to keeping a steady slow pace in going down the steepest hills.

Many people all over the country are turning their attention to the building of vehicles for their own use, if nothing more. They find no difficulty in getting a body to suit their fancy of any carriage builder, and wheels also are easy to obtain, but when it comes to the machinery and a vehicle framework to hold the several parts of that machinery in perfect alignment and at the same time have the necessary flexibility, the problem puzzles them. The machine here described just meets the requirements, being all self-contained and of such form that it may be stowed away in a neat and compact manner on the under side of any form of vehicle. A mechanical brake is also provided for, on a double flanged pulley keyed to the motor shaft. A brake applied at this point is extremely effective, owing to the great leverage of the motor on its work. These machines are being manufactured at Portland, Me.

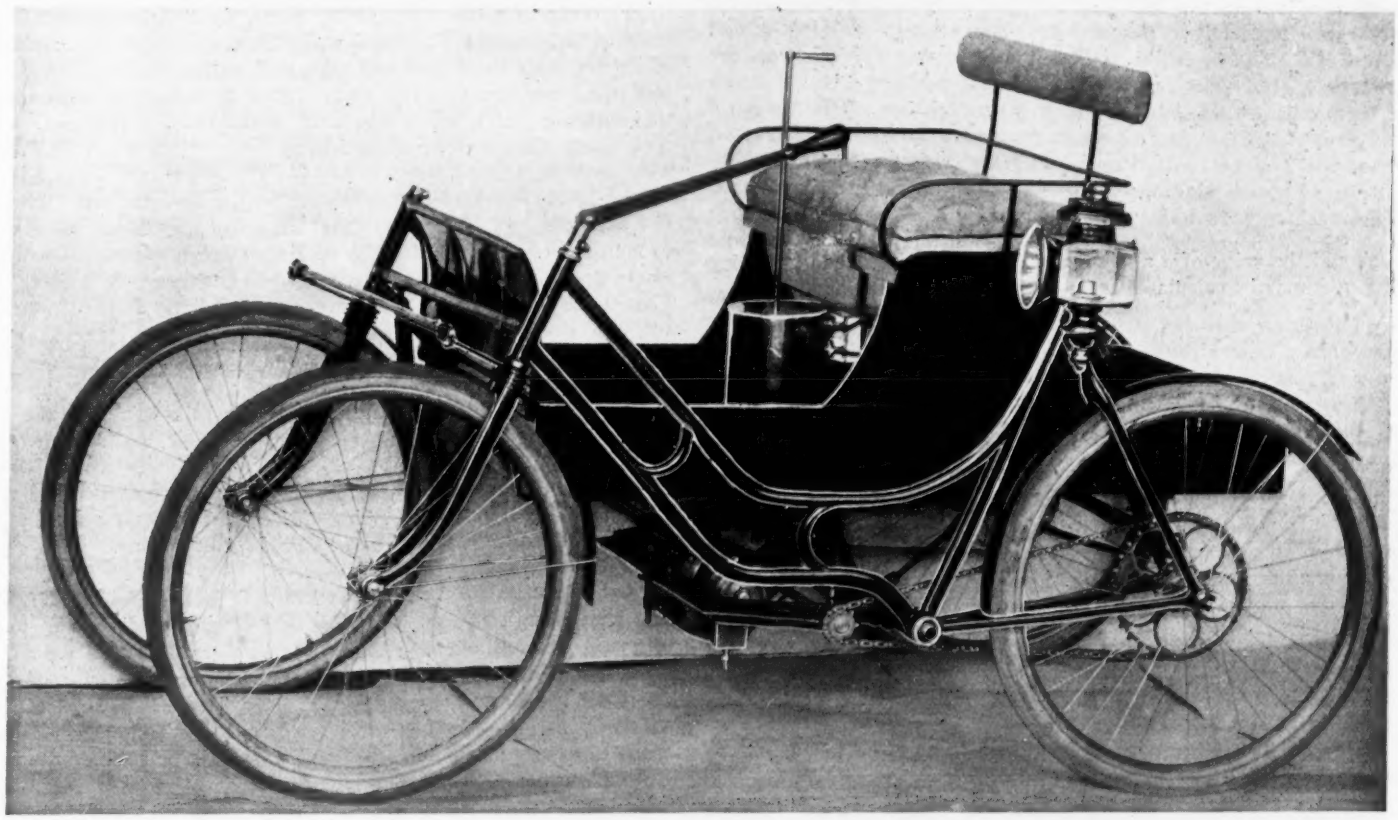


FIG. 3.—LIGHT WEIGHT STORAGE BATTERY AUTOMOBILE.

Increase of Resistance of Conductors to Alternating Current.

In a recent issue of *L'Industrie Electrique,* Prof. Hospitalier gives a simple method for calculating the increase of real resistance of conductors when carrying alternating currents as distinguished from direct currents. As is well known, such increase of resistance is due to what is sometimes termed the "skin" effect; that is, to the non-uniform flow of alternating current in a conductor, owing to a greater inductive action at the centre of the conductor than at the periphery.

Formulas have been given for calculating this increase of resistance by Maxwell, Rayleigh, Kelvin, Heaviside and others, but all are quite intricate in form. A very much simpler method proposed by Prof. Potier forms the basis of Prof. Hospitalier's article. As here reproduced, the constants are calculated for English units.

Let R_c be the resistance of a given wire for direct currents, and R_a the resistance of the same wire for alternating currents; then $R_c = R_a$, or k is a factor by which the resistance for direct currents must be multiplied in order to obtain the resistance for alternating currents; k, of course, can never be less than unity. In the accompanying table the values of k are given for successive values of a certain quantity, a, which is very easily calculated from the data of any given case by means of the following formula, thus greatly simplifying the otherwise intricate calculation:

$$a = \frac{1.915\ \pi}{10{,}000\ R}$$

in which R is the normal resistance in ohms per thousand feet of the conductor—that is, the resistance for direct currents—and n is the number of periods per second.

a	k
1	1.078
2	1.265
3	1.479
4	1.678
5	1.853
6	2.007
7	2.146
8	2.274
9	2.394
10	2.507
16	3.095
20	3.415
25	3.735

Should the value of a as thus calculated be greater than 25 or less than 1, k may be calculated from the following formulas:

$$a > 25 \qquad k = 0.25 + \sqrt{\frac{a}{2}}$$

$$a < 1 \qquad k = 1 + \frac{a^2}{12} - \frac{a^4}{180}$$

Since the formula for a does not involve the specific resistance of the wire as an independent term or factor, but contains it only in the value of R, it follows that the increase of resistance due to alternating currents is independent of the nature of the wire as long as the different conductors to be compared have the same resistance per foot. The reason for this seems to be that the "skin effect" becomes less marked the greater the specific resistance.

CURRENT NEWS AND NOTES.

ALTERNATOR BUILT BY STUDENTS.—Students in the department of electrical engineering, University of Michigan, are constructing a 5-kw universal alternator from designs and specifications worked out last year by two students as a thesis. The machine is designed to generate one, two or three-phase currents.

ANOTHER PACIFIC CABLE BILL.—On Feb. 9 another Pacific cable bill was introduced in the House of Representatives at Washington. It is intended as a substitute for the two bills now before the House, and provides for a cable to be constructed by a private corporation to which the government shall pay $200,000 a year in return for the free transmission of all government messages. Should no private company take the contract at the subsidy offered the government is to construct the cable at a cost not to exceed $12,000,000.

ARC LIGHT CARBON.—In a patent issued Feb. 6 to J. T. Robinson a method of treatment is described whereby, it is claimed, arc light carbons can be improved with respect to length of life, improvement in quality of light, and economy in consumption of energy. The process consists in soaking the ordinary carbon pencils from two to four days in an aqueous solution of caustic soda or potash, in which powdered talcous asbestos has been dissolved.

ILLINOIS INDEPENDENT TELEPHONE CONFERENCE.—Last week a meeting of the Illinois State Association of Independent Telephone Companies was held at Decatur. Among the subjects discussed was the combination of the systems to form trunk toll lines, extending from St. Louis through Illinois and Indiana, making Chicago and Indianapolis the objective points. Representatives were present from various places in the states named, as well as a number of electrical supply men.

PARIS EXPOSITION BUILDINGS.—A special cable despatch from Paris of Feb. 8 says: The *Echo de Paris* says that there are good reasons for stating that the Exposition authorities are anxious on account of the condition of the Seine, which, in rising, has done considerable damage already to some of the buildings along the banks. One of the wings of the building for the Palais d'Electricité has sunk about ten feet, it is said, on account of the infiltrations of water. The architects are said to be not certain that they will be able to restore the building to its former condition. On the other hand, the banks, where there are several lighter sorts of constructions, are not considered in danger unless the river rises higher.

GUTTA PERCHA.—At the French garden for the study of colonial plants, it has been discovered that the *Eucomia ulmoides,* which has hitherto been considered a worthless plant, is really an inexhaustible source of gutta percha, of which it contains 28 per cent. A paper was recently read on this plant in the Academy of Sciences, with the result that its author, Prof. Dybowsky, was inundated with letters requesting specimens of the plant, which is very plentiful in some of the English colonies, though it has never been used hitherto. Moreover, only the leaves and sprigs of caoutchouc have been utilized, the berry being thrown away. Prof. Dybowsky in experimenting with the berry discovered that it contained 5 per cent. more caoutchouc than the twigs and leaves.

GENERATION OF OZONE.—A patent was granted Feb. 6 to C. G. Armstrong and W. D. Neel on an apparatus for generating ozone on a commercial scale by means of brush discharges between electrodes. The apparatus is arranged like a steam condenser, with glass tubes containing conductors corresponding to the condenser tubes. At one tube plate space the conductor of every alternate tube is connected to one side of a high-voltage supply circuit, and at the other tube plate the remaining conductors are connected to the other side of the supply circuit; one end of each tube is closed, the connection being made at the other end. It is stated that if the two sets of conductors are connected to a source of high voltage, a brush discharge will occur between the tubes with the space corresponding to the condenser steam pace. Air is forced through this space and the brush discharge changes part of its oxygen into ozone.

COST OF ELECTRIC POWER AT MICHIGAN UNIVERSITY.—Recent calculations of the cost of electric light and power from the plant of the University of Michigan show the amount of work done for one year to be 179,700 kw-hours, at a cost of 3.112 cents per kw-hour. At the time the plant was installed the University was paying the Ann Arbor Electric Light & Power Company 13.39 cents per kw-hour. The total cost of operation of the plant during the period referred to was $5590. The cost of operating a 16-cp incandescent lamp per hour was 1.86 cent, and for each arc light per hour, 1.43 cents. Motors aggregating 35-hp and taking 140 amperes, besides a large number of lamps, have been added to the system. As now arranged, the system includes 5194 incandescent lamps of 16-cp each, 42 arc lamps of 1800-cp each, and over 20 motors, with an aggregate of 175-hp. It is estimated that the new homœopathic hospital will require 235 amperes, 100 for motors and 135 for lighting; and that the science hall soon to be built will take 370 amperes, 120 for motors and 250 for lighting. Including these, the maximum load, which is now 720 amperes, or 120 beyond the normal capacity of the two generators on the campus, will be increased to 1500 amperes.

ENGINEERING SOCIETY LIBRARY UNIVERSITY OF MICHIGAN

FIRE IN THE BROOKLYN NAVY YARD.—Fire on Feb. 11 destroyed building No. 7 in the Brooklyn Navy Yard, occupied by the electrical branch of the Equipment Department. The loss is stated to be $100,000, divided about equally between building and contents.

ZINC-LEAD STORAGE BATTERY.—A patent issued Feb. 6 to Henry Blumenberg, Jr., and F. C. Doerbury, describes a form of zinc-lead storage battery designed to obviate injury to the zinc element from several causes noted. The parallel zinc plates have legs at their lower edges projecting below the lower surface of the lead plates. These legs dip into troughs at the bottom of the cell containing mercury. The several zinc plates of a cell are clamped together by means of washers and a through bolt, both at the legs and wing projection near the top of the plates; in the latter case the connecting parts are of material not subject to electrical action, owing to the proximity to the lead plates. Between the lead and zinc plates, glass separating rods are placed.

NEW TYPE OF SINGLE-PHASE INDUCTION MOTOR.—In a patent issued Feb. 6 to Walter Langdon-Davies, of London, England, a type of single-phase induction motor is described having a peculiar arrangement of the primary member, and a commutator on the rotor. The field is wound on a slotted cylinder with no projectory pole pieces, and the windings so distributed as to make the magnetic density strongest at the centre of each pole-face. The rotor has a continuous winding coupled at intervals to commutator bars on which brushes bear on a line inclined to the magnetic axis of the field windings. By this means the axes of the field and rotor may be thrown out of coincidence and thus produce a starting torque. Moreover, by changing the angle of the brushes, the rotor may be given motion forward or backward.

LETTERS TO THE EDITORS.

Paralleling of Compound Dynamos.

To the Editors of Electrical World and Engineer:

Sirs:—The discussion now going on in your columns on the paralleling of compound dynamos is of more than passing interest, from the fact that nearly every installation from the small isolated plant to the large street-railway plant has encountered the problems presented when compound dynamos are thrown in and out of service on a common supply circuit.

In an article which I contributed to the ELECTRICAL WORLD of Oct. 30, 1897, it was shown how in the remodeling of a plant at the New York State Industrial School, the paralleling of two compound dynamos was accomplished by the use of a single-pole and a double-pole switch. The single-pole switch when thrown in closed both the shunt and the equalizing circuit, the positive and negative connection being made simultaneously. This arrangement, while not in keeping with the latest methods, worked very successfully, until overcompounded dynamos of much larger capacity were installed.

The new overcompounded machines under the same handling as the old dynamos, took the load with a rise of voltage, which should of course be expected. It was found however, that in connecting the old dynamos in circuit with the new, no deviation of voltage was perceptible. It was also found that by cutting in the new dynamos slightly under pressure, fairly good results were obtained. To be sure, a "dip"was noticed, but by studying each machine the plant was operated not with a mathematical nicety, but with fairly good results.

The writer feels safe in saying that no two dynamos will give the same performance for the reason that the fields in some are more sensitive than in others to an extent that the least variation in the magnetizing force creates very sudden change in the load. Of two multipolar dynamos even of the latest type, one will build up almost instantly, while the other may lead one to think that perhaps the field circuit has been broken, so slow is the action.

The handling of these machines when once in circuit has to be done with considerable skill. One can be run from no load to full load without altering the position of the brushes, while the other must be adjusted according to the load on it. Now it will be seen that if both machines are running and a load comes on, if the load is adjusted at the board and then the brushes set to the proper lead to meet this load, the load of one machine will be decreased and that of the other consequently increased, which retards rather than aids the object sought.

In Thompson's "Dynamo-Electric Machinery," edition of 1890, Mr. Mordey's plan of paralleling compound dynamos is given. Mr. Mordey's plan was to use single-pole switches.

First, the incoming generator is brought to voltage by closing the shunt; then the equalizer switch is closed, and finally the circuit switch, the series side being directly connected to the other side of system.

The system formerly used here had all equalizing wires in direct connection and on the negative side. One three-pole switch operated the shunt and positive and negative leads. For my part, I do not want to see any more switches performing two operations with a single throw—that is, to advance a switch to make one connection, then complete the throw to make the final connections. Neither do I believe in doing away with a switch when it will leave a wire connected to one side of the system. I believe that this was quite common, and not so very long ago. Paralleling the dynamos when the series or equalizing wires are left in connection, has been the cause of severe shocks, and no matter how small, the installation should not be allowed.

While much has been said about coupling compound dynamos in parallel circuit, little attention has been given to the cutting out of the dynamos. As an example, we will assume that two large dynamos, compounded or overcompounded, are carrying a half-load each. It is necessary to place the entire load on one machine. Can the load be thrown from one to the other without a variation in pressure? In the case of the compound dynamo a variation somewhat gradual will take place and can be readying adjusted at the board, without hardly being noticed.

The overcompounded dynamo will give rise to sudden variations not only perceptible but injurious to lamps, motors and engine. Of course, adjustment can be made, but not until after the strain has been exerted. It is understood here that the voltage rises, and hence we assume that to have the voltage correct after the disconnection, the system must suffer a drop before. The voltage of the machine taking the load must be increased and that of the other lowered to reduce the current to a safe handling at the switch. Perhaps it would be more proper to say that the dynamo being cut out produces a change in the system which, when released, causes the other to jump the pressure of the system above normal.

Prof. Anthony in his letter says that if the machines are evenly compounded, which all machines used in multiple should be, no further adjustment should be needed. Do we find all dynamos used in multiple evenly compounded? I think not, and doubt if a third are. Prof. Anthony would have an ideal plant if he had added, "and all engines running dynamos also operating as a unit."

We must meet the situation as it is, and not as it would be, providing all things could be made perfect. Additions to plants must be counted on that are not in keeping with the old types. It is not right to expect a remodeling every time an increase in service is demanded, and the new dynamos must work measurably well with the old. It is a problem for the engineer to solve for each individual plant. With our old compound dynamos good service was obtained. To be sure there were variations in voltage, but they were gradual and not of the character experienced with the new machines. I do not wish to imply that I would replace the new dynamos with the old type. The day load can be carried by one dynamo, being a variable load, and it is convenient to use the overcompound dynamo, as it makes the system practically self-regulating and with little attention.

ROCHESTER, N. Y. J. T. FREEMAN.

Parallel Operation of Direct-Connected Alternators.

To the Editors of Electrical World and Engineer:

Sirs:—I have read with great interest the discussion being carried on in your pages on the parallel operation of direct-connected alternators. One very important point seems to have escaped notice in this valuable discussion, viz.: the all-important question of armature reactions. Calling the generator carrying the load on the busbars *A*, and the one about to be put in, *B*, and assuming that *A* is carrying full load, then if we adjust *B's* voltage to the same as *A's* and throw in *B*, the load will not divide equally between the two generators, no matter whether they are exactly in phase or not, and no amount of field adjustment will make *B* take its share of the load, or, in fact, any of the load.

This is due to the armature reaction, which is specially marked at

low field excitation. *A*, carrying the load, has already had its field adjusted to compensate for this armature reaction, and when *B* is thrown in multiple with it, a slight difference of phase is sufficient to allow *A*, the lagging generator, to send an almost wattless current into *B*, and, by means of the armature reactions, tend to demagnetize *B's* fields, finally driving it as a motor. Strengthening the fields of *B* merely increases the idle current between the machines, and as a definite angle of lag of the generator *A* behind the motor *B* has been established, the only thing left to do is to pull out *B* and try again and again until we happen to strike the same angle of lag or lead in both machines. To obviate this very annoying process, the writer suggests the following method, which is now used by the company with which he is connected.

Plot the external characteristics of the generators and from the curve tabulate a series of values to which the voltage of the generator *B* must be raised before throwing in multiple with *A*, in order to get the same voltage when carrying the same load.

The following table, taken from actual figures used in putting two 400-kw two-phase generators in multiple, will serve to illustrate the method:

Generator A.	Generator B.
Per Cent. of Full Load.	Per Cent. Increase in Voltage Above Busbar Pressure Before Putting In.
25	3
50	7
75	10
100	12

When the pressure has been increased to the above values the machines go together perfectly without any noise or grunt and immediately divide the load equally.

HENRY G. STOTT.

BUFFALO, N. Y.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Synchronous Converters.—HERRMANN.—A short illustrated article suggesting some alterations in the design of synchronous converters for transforming three-phase into continuous current. The ordinary converter varies but little in mechanical construction and general appearance from a direct-current dynamo. The only object of the field of the magnet poles is to produce the synchronous rotation of the armature necessary for proper commutation, but this field does not produce the continuous current, and its action is therefore quite different in continuous-current dynamos and in synchronous converters; hence, if the armature of the converter is driven by any synchronous motor of the same number of poles, it is superfluous to excite its magnets; the frame then fulfils the purpose of closing the magnetic circuits, and may therefore be constructed as a simple ring without pole-pieces. Such a machine would differ from an ordinary converter only in the phase difference between current and e. m. f. By regulating the exciting current in the ordinary converter the phase difference between current and e. m. f. of the alternating current may be reduced to zero, and by overexcitation even a leading current can be produced, which is impossible with the new arrangement, in which the current always lags, and the more, the greater the magnetic reluctance; the latter is rather large as long as there is an air gap between the stationary frame and the revolving armature; but there need be no air gap at all, if the frame is made of laminated iron like the armature and rotated with it; the armature and frame thus become a single ring, in which a rotary field revolves. The winding which produces the rotary field, is placed in holes, which are equally distant from the outside and inside cylindrical surfaces and parallel to the axis. It may be either a drum or a ring winding; in the latter case the wires must return either over the outside or the inside surface of the iron core. The connections with slide rings and commutator are exactly the same as in the ordinary converter. If now this ring is driven synchronously, but in the opposite direction to the rotary field of the alternating current, then the field is fixed in space, and continuous current can be taken off. Experiments with a small experimental machine gave satisfactory results; for larger machines he suggests making the armature stationary and revolving the brushes around the collector. The synchronous motor for revolving the brushes can be small, and the construction of the stationary armature would be very simple. If high pressure alternating current is to be converted into low pressure continuous current, the step-down transformers then become superfluous, as there may be two instead of one windings in the holes, one with the large number of turns connected with the high tension, and the other with a smaller number for the continuous current; the small synchronous motor would require a small transformer, but even this can be avoided, as an alternating current may be taken off from the low tension winding. The machine may also be used as a phase transformer so that with one machine high-tension three-phase current may be transformed into continuous current and alternating current of low tension and the latter may be three-phase current for motor driving and single-phase for lighting.—*Elek. Zeit.*, Jan. 18.

Friction Losses in Dynamos.—HAY.—A short article in which he attacks the opinion that the friction loss depends directly on the bearing pressure and that any cause which increases this pressure—such as an increase in the tension of the driving belt, or a slight want of symmetry in the magnetic field—will also increase the friction loss in the same ratio. He calls attention to the fact that the friction loss is a problem concerning the behavior of a thin film of viscous liquid, as with proper lubrication the journal is completely separated from its bearing by a thin film of the lubricant, so that the loss of energy is due to the tangential stresses in the lubricant, and not to abrasion between two solid surfaces. He refers to the theory of lubrication, developed by Reynolds and based on the hydrodynamical equations for a viscous fluid, and describes the more recent experiments of Dettmar (Digest, Oct. 7).—Lond. *Elec. Rev.*, Jan. 26.

LIGHTS AND LIGHTING.

REFERENCES.

Sussman Lamp.—An illustrated description of the latest form of the Sussman lamp for coal mines (Digest, Dec. 30, under Electricity in Bines).—*Eng. and Min. Jour.*, Dec. 9; *Elec. Rev.*, Jan. 31.

Twin Carbon Arc Lamp.—MATHIESSEN.—A reprint, with illustration, of the article noticed in the Digest Feb. 10.—*El'ty*, Feb. 7.

POWER.

Continuous and Polyphase Power Plants for Factory Use.—An anonymous article comparing both systems. The advantages of multiphase machinery are said to be: the greater cheapness in prime cost, size for size; the absence of a commutator, causing a smaller maintenance cost of motors; the greater simplicity of the starting and switching arrangement, combined with a smaller prime cost and maintenance cost. The disadvantages of multiphase power plants are said to be: that the starting torque is poor compared with that of a continuous current motor; overloading multiphase motors is impossible, so that in deciding what size of multiphase motor to use to drive a tool, one has to be guided by the peak of the power curve, whereas with the continuous current motor, one would look at the average height of the power curve, and rely on the overloading power of the motor to carry one over the peaks; the use of three or more wires to each motor in a factory, in place of two; the impossibility of regulating the speed of a multiphase motor to a nicety; the difficulty to take rough readings in the shop. He therefore thinks that the multiphase system does not seem so accommodating and flexible for power work as the continuous current system. He has visited some English multiphase power plants and concludes that possibly the American and continental manufacturers of multiphase machinery "have more up their sleeve than they will divulge, and also that their make of motor is superior to the ones made in this country, to which alone the above descriptions refer."—Lond. *Elec. Rev.*, Jan. 26.

Long Distance Transmission.—ADAMS.—An article on the economics of long distance electric power transmission. He refers to a prospectus of a company proposing to develop a water power in

Western Illinois and transmit it electrically over 40 miles, selling it in competition with steam power. He claims that the investment for a long distance electric transmission and the losses of power involved, are so large that with absolutely free mechanical power at the start, the distance to which it can be electrically transmitted and sold at a profit in a district where fuel is as cheap as in Central Illinois, is probably less than 25 miles. He gives an itemized estimate of the cost of a 40-mile transmission and finds that if a good water power is already developed and can be had at the wheel shaft for $15 per year, the cost in a transmission system for 40 miles is 2.7 times as great as the fuel cost in a steam plant to deliver the same amount of electrical energy at the point of distribution. The long distance electric transmission system must pay interest, depreciation and repair charges on from 1.27 to 1.94 times as great an investment for the transmission as for the local system. The article is also commented upon in an editorial note.—*Eng. News,* Feb. 1.

Water Power in Italy.—RADDI.—An article on the utilization of water power in Italy, which is a country destitute of coal. The government regulations controlling the utilization of water power are discussed. Four million tons of coal are now imported annually. The total amount of water power available is estimated at 10,000,000-hp. The cost of a steam horse-power is found to range between $290 for a 1-hp engine to $30 for a 500-hp engine per year of 3300 working hours. The cost of an electric horse-power depends largely upon the cost of installing the permanent plant and the conditions in Italy are said to resemble somewhat those in Switzerland. The power house of Zurich cost $100 per horse-power, or $240, if the cost of the electric plant and the transmission to Zurich is included. Plants at Paderno and Vizzola have cost for the hydraulic works and power house alone $120 per horse-power, and from $200 to $240 including the electrical portion. Much lower costs than these are possible when the power house is situated in the mountains. The plant on the Isere cost only $34 per horse-power, and one in Haute Savoie of 6000-hp from a fall of 140 meters costs but 16.6 per horse-power. Metallurgical and some electrochemical plants may be built to advantage in the mountains.—*Eng. Mag.,* February.

Electric Power in Mining.—BLOEMENDAL.—An article on the use of electricity in large mines in Bohemia and Hungary, especially for pumping and hoisting, ventilation and for coal cutting machines. For all such applications the polyphase current proves satisfactory, but for general traction purposes the continuous current is still preferred. The use of polyphase transmission and of synchronous converter substations for traction purposes, is discussed. The greatest cause of trouble with electric driving has been that of short-circuiting, due to defective insulation, but the improvements in the insulating materials have rendered accidents from this cause quite remote in new installations. Motors and generators are now made so as to be practically unaffected by dampness. The danger of the ignition of mine gases by sparking, has been removed by the production of non-sparking dynamos.—*Stahl und Eisen*; abstracted in *Eng. Mag.,* February.

Transformer Turbine.—PRASIL.—A series of articles describing what he terms the transformer turbine, by means of which sufficiently high rotative velocities are obtained from low heads to permit of the use of direct-connected dynamos. The principle is that a portion of the water flows through one wheel which moves a set of guide vanes which direct the balance of the water against the buckets of the main turbine, which latter therefore revolves at a speed equal to the sum of the revolutions of both the systems.—*Schweiz. Bauzeit.*; abstracted in *Eng. Mag.,* February.

REFERENCE.

Electric Motors for Lifting Apparatus.—NIETHAMMER.—The conclusion of his long paper (Digest, Feb. 10) describing the speed control of continuous and three-phase current motors, several forms of electric brakes, some types of electric elevators and overhead traveling cranes, and the use of electric motors on ships, bridges, mines, harbors, canals and railway stations. The article is well illustrated.—*Elek. Zeit.,* Jan. 18.

TRACTION.

Accumulator Traction.—ALBRECHT.—An article referring to the breakdown of the mixed trolley and accumulator systems during the recent snowstorms in Berlin (Digest, Jan. 27). The following points are given: the batteries were discharged too soon, because they had not been fully charged from the trolley system; there was much gassing and a strong smell of acid on account of unduly strong charging or overcharging on single points of the line, the size of the batteries being too small; sometimes breakdowns in the power house occurred, which caused a stop of the whole traffic, as the capacity of the batteries was too small to help out. It is shown that these causes of stoppages do not exist in the pure accumulator system. In Dresden the mixed trolley and accumulator system has proved very satisfactory, although the topographical difficulties are greater than in Berlin. He calls attention to the fact that in Dresden grid plates with active materials are used, while the Planté type is used in Berlin. He states the following disadvantages of the Planté type: the active material of the negative plates very soon loses its activity on account of too rapid charging with high current density or overcharging; the chemical processes combined with changes of volume occur too rapidly, as the charging and discharging take place too quickly, there is vivid gassing and perpetual corrosion. The disadvantages of the quick decrease in capacity of the Planté type as used for traction purposes, is counterbalanced only slightly by the possibility of using large current densities. The Planté type is, however, said to have proved satisfactory in the combined accumulator and trolley system in Hanover.—*Elek. Anz.,* Jan. 1, 7.

Rapid Transit Problem in Germany.—A discussion of the equipment of the Berlin-Wannsee Railway with electricity, it being at present operated by steam. It is proposed to use the alternating current, and trains having an eight-wheel motor car at each end and two or four trailer cars between them; trains of as many as ten cars are to be used. The three-phase system with three-phase motors was considered feasible, the distribution being at 15,000 volts reduced to 1000; 60 cycles are to be used for the greater part of the lines, but just in front of each station a section of the track is to be fed with three-phase currents at 15 cycles; in approaching a station the motors will then act as induction generators and therefore as a brake. It is proposed to use steam turbines in the station. An alternative proposition is to dispense with substations and take the 15,000-volt current from the overhead wires by means of a sliding bow contact, transforming the current to 1000 volts by transformers on the roof of the cars.—*St. R'y Jour.,* Feb. 3.

Detroit.—An illustrated description of the new equipment of the Rapid Railway, which was one of the first high-speed interurban railways in this country; originally it was 20 miles long, and is now being extended to 73; the power will be distributed from one station over the entire line by alternating currents. The station contains three engines of 1000-hp, each direct-connected to a 500-kw three-phase generator. The current will be distributed at 16,500 volts; there will be five substations containing two or three rotary converters of 200-kw.—*St. R'y Jour.,* Feb. 3.

International Traction Company.—A long illustrated description of the generating plant at Niagara Falls and the plant of the International Traction Company of Buffalo, which absorbed a number of railway lines, and gets its power from Niagara Falls. The power used in Buffalo is raised to 11,000 volts and is transmitted about 22 miles; a map shows the distribution in Buffalo, which is underground. The power for the traction company is taken at 11,000 volts and transformed to 500 direct; the contract calls for 5000-hp continuously for 24 hours, and therefore large accumulators have been installed for storing; the rotaries are described and illustrated; they are started with direct current. All switching is done on the high tension circuit, and the switches will be of the oil type; the high tension circuit also contains a special circuit breaker with a time element, which prevents a short circuit at one substation from throwing out all of the circuit breakers back to the station, before the current can be broken; those nearest the station require the longest time to open. The rotaries are synchronized on the high tension switch.—*St. R'y Jour.,* Feb. 3.

Testing Resistance of Rail Bonds.—An illustrated description. A truck is constructed the rear wheels of which are insulated from each other and from the front pair; there are four metallic brushes on each side between the wheels, touching the rails. There are two voltmeters each reading to three volts, an ammeter for 200 amperes, a rotary converter to reduce the voltage and a regulator to control its speed. The five-volt current of the rotary passes to one rear wheel, then through the rail to the forward wheel on the same side, then across the axle to the opposite forward wheel and back to the other rear wheel through the ammeter to the converter. The test car is drawn behind a regular motor car. Joints can be tested at the rate of 3½ miles of track per hour, or bad joints at the rate of 6 miles per hour. A pump filled with whitewash is carried on the car, some of the con-

tents of which are ejected at each bad joint.—*St. R'y Jour.*, Feb. 3.

Automobiles.—A short description of some types of automobiles manufactured by an English company. A dogcart with seats for four is illustrated, which is driven by an enclosed 5-hp electromotor geared to the rear axle, the current being supplied by 62 Crowdus cells weighing 1484 lbs., and giving 22 hp-hours at a four hours' discharge. There are four speeds of 3, 6, 9 and 12 miles per hour respectively, obtained by paralleling the cells. An average run of 50 miles with one charge is obtained with four passengers. There is an automatic electric brake, charging the cells, which is the one used under ordinary conditions; a rim brake, engaging on aluminum plates on the driving wheels; a band brake on the live axle working in both directions. By a special arrangement the controller is returned to zero before the foot brake can be applied.—*Ind. and Iron*, Jan. 26.

Electric Automobiles.—Chapman.—A short article of a general nature. He believes the electric vehicle to be the best for cab service, private business, pleasure, physicians' use in city or country, delivery of merchandise and omnibus service, provided the routes are not too long. It is the simplicity of operation which commends the electric vehicle for city and suburban use.—*The Automobile*, January.

REFERENCES.

Combination Steam and Electric Railway in Illinois.—A long illustrated description of this line which is about 29.5 miles long, electricity being used for passenger service and steam for freight. The trolley wire is in the form of an 8, the upper part being rolled into a flat surface with sharp corners so that it can be clamped by the insulator. The power house and other features are illustrated. The cars have four motors of 35-hp, and air-brakes.—*St. R'y Jour.*, Feb. 3.

A Double Trolley in Washington.—An illustration showing the method of construction of the overhead wires. The poles are pressed apart at the top by a two-inch pipe; the interval between the poles is 100 feet; the insulators are double bells; the two trolley poles are mounted on separate bases.—*St. R'y Jour.*, Feb. 3.

Overhead Electric Traction.—Baxter.—The second part of his article on "What makes the trolley car to go?" (Digest, Jan. 13) giving a popular description of the wiring of the car, the controller, the connection of the line with the generating station, and the switchboard.—*Appleton's Pop. Sc. Mo.*, February.

Electric Railway Power House.—An illustrated description of the electric equipment of the Union Traction Company of Philadelphia, controlling 450 miles of railroad track. The lines are operated from seven main power stations and three substations. These ten stations have 38 generators, with an aggregate of 40,000-hp.—*Elec. Rev.*, Feb. 7.

Rail Welding.—An illustrated description of the Goldschmidt process taken from a paper by Goldschmidt and another by Beyer. The method has already been described in the Digest; it consists in mixing powdered iron oxide with powdered aluminum and igniting the mixture, which produces a high temperature and melts the reduced iron. The cost of a joint is about $6.25 as compared with $8.75 when fishplates are used.—*St. R'y Jour.*, Feb. 3.

Cars.—Illustrated descriptions of four Stevenson cars, including a large folding chart showing the details of all parts of a double truck closed car for the Brooklyn road.—*St. R'y Jour.*, Feb. 3.

Installations, Systems and Appliances.

REFERENCES.

Systems of Distribution.—Guilbert.—Brief, well illustrated descriptions of various new systems for distributing electrical energy by alternating and continuous currents, taken from patent specifications.—*L'Eclairage Elec.*, Jan. 6.

Toledo.—Harding.—A description of the plant, which supplies both lighting and railway currents, using both direct and alternating currents.—*St. R'y Jour.*, Feb. 3.

Wires, Wiring and Conduits.

India Rubber.—Schaefer.—An article on india rubber as insulating material for cables, criticising some statements in the paper of Terry, abstracted in the Digest Jan. 20. The manufacture of seamless india rubber wires is said to be neither new nor to be recommended—at least not to users; its drawback lies in the fact that on account of their elasticity good strong elastic rubbers like Para, cannot be pressed through the machines of the seamless process, unless heated to such an extent that they perish; the only rubbers suitable for working in such machines are cheap, soft qualities. The failure of underground india rubber cables in England is not necessarily due to bad material or bad workmanship; the principal cause lies in the faulty use of india rubber insulated cables. Such cables or wires should not be used underground, in mines, or in other places where they are exposed to gas, stagnant air, or moisture, without being cased in lead. If they are covered only with a tape and braiding, or if they are iron armored, the india rubber deteriorates under the action of gas and moisture. To obtain all possible advantages from a lead casing on india rubber cables, it is necessary that the lead lies tightly on the india rubber or on the tape surrounding it. In multiple core cables each core should have its own covering of lead, as otherwise the fibrous worming and serving yarns are liable to get soaked with moisture at the ends or at faults in the lead.—In an editorial note attention is called to the difficulty of pressing a tight lead covering on rubber cables, especially if the jute braiding which usually surrounds the core, is omitted, as it should be. With a hot lead press it is difficult to cover the wire without burning the insulation under these conditions, and although one firm has used a cold lead press for several years, this type is not popular. More information about such matters is wanted.—Lond. *Elec.*, Jan. 19.

Aluminum and Copper Wires.—A table of comparisons communicated by the General Electric Company, of Berlin, giving the cross-section, the resistance per 1000 meter, the number of single wires forming a cable, the diameter of the single wires, the total diameter, and the weight per 1000 meter, for 25 different sizes of copper and aluminum wires and cables, the resistance of aluminum being assumed at 0.02874 ohm per meter and sq. mm. at 10° C.—*Elek. Rund.*, Jan. 1.

Use of Aluminum for Feed Wires.—Some notes on the introduction of such feed wires which are coming into extended use. Small wires, that is, those about one-half-inch in diameter, are joined by means of a double sleeve coupling which after the wires are inserted, is twisted and the wire soldered. In larger wires the ends are placed in brass sleeves and soldered with pure block tin, red phosphorus being used as a flux, the surface having been previously treated with hydrofluoric acid.—*St. R'y Jour.*, Feb. 3.

Electro-Physics and Magnetism.

Diselectrification Produced by Magnetism.—Phillips.—An abstract of a Royal Society paper. He found that under certain conditions an electrified body rapidly loses its charge when in the neighborhood of a magnetic field; nor does it appear, so far, essential that there be any relative motion between the lines of magnetic force and the charged body itself. He made experiments with a glass tube, at the centre of which there was cemented upon the inner and outer surfaces a strip of tinfoil. The pole-pieces of a powerful electromagnet projected into each end of the glass tube through an air-tight flange. When the gas in the tube was rarefied to a pressure lower than 0.2 mm., and when the inner coating was positive, the sudden collapsing of the leaves of an electroscope connected to the outer coating pointed to the removal of the charge through the action of starting or stopping the magnetic flux. Although the effect was more powerful at the moment of making or breaking the magnetic circuit, it persisted in a modified degree as long as the magnetic field existed. The leaves of the electroscope were then connected to one of the internal pole-pieces, and it was seen that if sufficient positive electricity were supplied to the inner coating while the magnet was excited, it became rapidly withdrawn, and ultimately resided upon the pole-pieces themselves. The experiment is commented upon in an editorial note and attention is called to the fact that although neither the magnetic field nor the charged body need be in motion, there are moving charged molecules in the exhausted interspace; the presence of these may be the cause of the transfer of electric charge from the charged body to the magnet poles, and their motion may afford the necessary conditions.—Lond. *Elec.*, Jan. 26.

Hall Effect at Low Temperatures.—Everdingen.—An account of a continuation of his experiments on the Hall effect and the properties of bismuth at low temperatures. By lowering the temperature from 15° to 90° the Hall effect is increased in all cases, especially in a weak field of 1300 units, where it is nearly doubled. The alteration of the resistance of bismuth by a magnetic field depends upon the angle which the lines of force make with the crystallographic axis. This should be remembered in measuring instruments using bismuth coils.—*Proc. Akad. Amsterdam*, Nov. 25; abstracted in Lond. *Elec.*, Jan. 19.

Röntgen Rays.—Rollins.—A continuation of his serial. The experiments supposed to prove the theory that the velocity of the particles of the cathode stream is the same for all gases, can be ex-

plained by saying that at the degree of vacuum used for light, the charges in the cathode stream are carried by hydrogen whatever the nature of the gas with which the tube is supposed to be filled. The correctness of the theory of a constant relation between mass and charge of an ion is questioned.—*Elec. Rev.,* Feb. 7.

REFERENCES.

Energy of Currents.—PEROT.—A theoretical article, starting from the law of induction and developing the laws of electromagnetism, basing them on what he calls the potential energy of an electric current.—*L'Eclairage Elec.,* Jan. 6.

POTIER.—A short article criticising some points in the article of Perot.—*L'Eclairage Elec.,* Jan. 20.

Double Refraction.—PASQUINI.—An account of an investigation of the double refraction of the electric lines of force in crystals.—*Il Nuovo Cimento,* March, 1898; an illustrated French abstract in *L'Eclairage Elec.,* Jan. 6.

Radiography.—DELEZINIER.—A note describing some experiments with three-phase currents in radiography.—*Comptes Rendus,* Vol. 129, p. 1227; *L'Eclairage Elec.,* Jan. 6.

Dielectric Constants.—COOLIDGE.—An account of measurements of the dielectric constant of some rarefied gases and several liquid dielectrics by a modification of Drude's method.—*Wied. Ann.,* September; a French abstract in *L'Eclairage Elec.,* Jan. 6.

Terrestrial Magnetism.—This issue contains a paper in German by Elster and Geitel, in which they point out that the supposition of free electric ions in the atmosphere is the best foundation for a rational theory of atmospheric electricity; a short article by Littlehales on the magnetic anomaly near Kursk, Russia; a note in French of De Tillo on the relation between the distribution of the magnetic elements and the general distribution of the water and mean annual temperature, over the earth; he offers a proof of his former statement that "for every magnetic element the earth represents two hemispheres in the longitudinal direction;" an English translation of a former article by Heydweiller on new magnetic intensity variometers; an article in German by Luedeling on the diurnal variation and on magnetic disturbances in polar regions, accompanied by an English abstract; an article in German by Eschenhagen on the installation of stationary and temporary magnetic observatories; and a brief biography, with portrait, of Prof. Wild.—*Terres. Magnetism,* December.

ELECTRO-CHEMISTRY AND BATTERIES.

Adhesion of Electro-Deposited Zinc to Steel.—COWPER-COLES.—A short article describing a series of experiments made to test the adhesion of electro-deposited zinc under varying conditions. A number of specimen plates of mild Sirna steel received a careful preliminary treatment, which is described, and were then coated with zinc at current densities varying from 15 to 30 amperes, advancing 5 amperes at a time, for a sufficient time to allow a calculated deposit of 1¼ oz. per sq. ft. They were then subjected to special tests which are described, showing that the zinc coating was not adhesive. In another series of experiments the plates were treated in exactly the same way, with the exception that before galvanizing they were placed in the zincing bath, and the current caused to flow in the opposite direction to that required to deposit zinc upon them, for a period of 2½ minutes; the current was then reversed and the zinc deposited as described above with the result that it was found to be adhesive; there was very little difference between the general appearance of the deposits in the two cases. The electrolyte contained 35 oz. of zinc sulphate per gallon, the acidity being about 0.2 oz. per gallon of free sulphuric acid. Another set of experiments was made to determine the cause of the non-adhesion of zinc deposited on iron from neutral solutions of zinc sulphate; the deposits were smoother and more even, but non-adhesive. The cause is probably due to the formation of a film of oxide on the iron plate when it is first immersed in the electrolyte. He thinks that the best deposits of zinc could probably be obtained by using neutral zincing solutions, and, after placing the cathode in the bath, momentarily reversing the current, so as to remove the film of oxide formed and thus secure an adherent deposit.—Lond. *Elec.,* Jan. 19.

Cleaning Metallic Surfaces.—A description of an electrolytic method devised by Burgess. The metallic surface to be cleaned from layers of fat, etc., is suspended as cathode in a concentrated solution of chloride of sodium or hydroxide of sodium. A surface is cleaned by a current density of 20 amp. per 143 sq. in. in 15 minutes, or by one of 140 amp. in three-fourths of a minute. With a solution of hydroxide of potassium a surface of iron is cleaned instantaneously by a current density of 80 amp. per 143 sq. in.—*Uhland's Tech. Rund.,* 1899, 15; abstracted in *Elektrochem. Zeit.,* January.

Galvanic Cells.—PETERSEN.—A proposal of the following modifications of galvanic cells. If in the Bunsen cell the sulphuric acid is replaced by a solution of chloride of sodium, neither the e. m. f. nor the internal resistance is altered; amalgamation of the zinc becomes superfluous. Instead of nitric acid he proposes to use sesquichloride of iron; such an element has all the good properties of a Leclanche cell, and is besides very constant; the e. m. f. is 1.72 volts and the internal resistance of a cell of the ordinary size is 0.3 to 0.4 ohm. If chloride of iron is used and an iron electrode instead of carbon, the same cell gives a current of 1.2 amp. during 72 hours at a (probably average) voltage of 0.537. A plunge battery with an e. m. f. of 1.6 volts can be made with a zinc and a carbon plate in a solution of ferric chloride, or better, in a solution of red prussiate of potash. The internal resistance of a Daniell cell is diminished by the use of chloride of magnesia instead of sulphuric acid; even better results are obtained with chloride of sodium, but the sulphate which is formed tends to crystallize so that the diaphragm is destroyed.—Lond. *Eng'ing,* 1899, 8, 27; abstracted in *Elektrochem. Zeit.,* January.

Maarssen Accumulator.—A description of this accumulator of Dutch make. A clay cell is placed in a glass tank which holds the sulphuric acid that may flow through the clay cell; the latter is divided by porous clay diaphragms into several partitions filled with a paste which consists of a mixture of a sulphate of an alkali, oxalate of calcium, and sulphate of lime, formed into a paste by sulphuric acid and oxides and peroxides of lead. In this paste the dents of a lead comb are plunged. The surface of the electrodes is large enough to yield a high capacity. There is no local action of the sulphuric acid upon the lead plates.—*Elek. Rund.,* 1899, 13, 159; abstracted in *Elektrochem. Zeit.,* January.

Cost of Calcium Carbide.—An article discussing the question of the cost of calcium carbide. It is mainly one of the cost of power, as it is produced successfully only in the electric furnace. The mean of several reports from manufacturers gives 8744 hp-hours as necessary for the production of one long ton of carbide, while the theoretical value is 5208 hp-hours.—Lond. *Engineer;* abstracted in *Eng. Mag.,* February.

Conductivity of Non-Aqueous Solutions.—LINCOLM.—A long account of measurements of the conductivities of salts in different solvents. He finds that the dissociation theory of aqueous solutions cannot be extended to solutions in other solvents. The degree of dissociation found from the conductivity does not agree with that found from increase of the boiling point. Neither Ostwald's nor Rudolph's law are correct for non-aqueous solutions. The molecular conductivity often diminishes with increasing dilution. The conductivity of the electrolytes depends largely upon the nature of the solvent, but there is no strict classification possible so far.—*Jour. Phys. Chem.,* Vol. 3, p. 457; abstracted in *Zeit. f. Elektrochemie,* Jan. 18.

Theory of Ions Applied to Metals.—DRUDE.—An outline of a mathematical theory of the electric current in metals, based upon the supposition that the transport of electricity is accomplished in this case also by electrically charged ions. Each ion transports the electricity only over very small distance and then gives its charge to another ion, there is therefore no transport of matter. From his equations he draws conclusions concerning the optical behavior of metals which are in approximate agreement with former measurements.—*Phys. Zeit.,* Jan. 6.

REFERENCES.

Switchboard.—KLINGELFUSS.—An illustrated description of a switchboard for electrolytic laboratories, connected to a continuous lighting current in combination with an accumulator battery. There are six independent circuits, each being supplied with current from two cells. For charging, the cells are connected in series with a lamp on the switchboard to the continuous current lighting circuit.—*Zeit. f. Elektrochemie,* Jan. 18.

Electrolytic Preparation of Fluorine.—MOISSAN.—An illustrated description of the copper apparatus used for the purpose, as noticed in the Digest Aug. 5.—*Sc. Amer. Sup.,* Feb. 3.

Electrochemical and Electrometallurgical Industries.—KERSHAW.—A reprint of that part of the article noticed in the Digest Jan. 27, which deals with alkalies, bleach and aluminum.—*Sc. Am. Sup.,* Feb. 3.

Calcium Carbide.—CARLSON.—A long English abstract of the German article noticed in the Digest Jan. 13.—Lond. *Elec.,* Jan. 19.

Voltaic Cell.—COOPER.—The first part of an article on the electrolytic mechanism of the voltaic cell, giving a brief outline of the development of the modern dissociation theory of solutions, especially of the work of Hittorf, Clausius, Arrhenius and Kohlrausch.—Lond. *Elec.*, Jan. 19.

Accumulator Tests.—DE COURCY.—An article on the recently closed competitive accumulator tests of the Automobile Club of France (Digest, Feb. 10). The jolting apparatus and the revolving commutator for the required variations of the rate of discharge are illustrated. *West. Elec.*, Feb. 3. The jolting apparatus is also described and illustrated in *Sc. Amer. Sup.*, Feb. 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Polarization.—MOORE.—A long illustrated account of a series of experiments in which he investigated the polarization and the internal resistance of the copper voltameter. He calls attention to the fact that the observations for electrolytic resistance by means of the direct current, unlike those for the alternating current, have never given uniform results and that the resistance is always larger when the current is small. The method of measuring electrolytic resistance by direct current involves the measurement of three quantities: e. m. f. at the terminals of the electrolyte, current and polarization. The determination of e. m. f. and current is easy and accurate, but the polarization is not usually measured with the direct current still flowing. The circuit is broken and the voltmeter thrown upon an independent current; the process requires time and a residual part only of the polarization is measured; the nearer the time between the opening of one circuit to the closing of the other approaches zero, the more accurate the values obtained for the polarization, and therefore the more accurate the calculated value of resistance. The object of his experiments was to emphasize these conditions and to show the growth of polarization upon closed and open circuit. He measured the polarization between .00006 second and .045 second after the polarizing e. m. f. was removed and applied the latter to wide ranges both in value and duration; the results are given in tables and diagrams.—*Phys. Rev.*, January.

Comparing Two Self-Inductances.—CARPENTER.—An illustrated description of a new method, the principle of which is as follows: The two coils whose coefficients of self-induction are to be compared, are connected in parallel; in series with one of them is a variable non-inductive resistance. If an harmonic e. m. f. is applied to the common terminals of the two branches, and the currents in both branches are brought into the same phase relation to the e. m. f. by varying the non-inductive resistance, then the ratio of the two coefficients of self-induction is equal to the ratio of the total resistances of the two parallel branches, including the resistances of the coils, the variable resistance in one branch, and the connecting wires. The condition of phase equality is detected by means of the telephone or, better, by an electrodynamometer; in the former case a secondary coil is placed near each one of the two coils under test, and these two secondaries are connected in series with the telephone. The method has been carefully worked out and is described in detail, together with the results of some tests.—*Phys. Rev.*, January.

Alternating Current Instruments.—ADDENBROOKE.—A communication in which he refers briefly to the use of electrostatic instruments for alternating current measurements. He has devised an alternating current wattmeter and also a sensitive "electrostatic ammeter" which is an electrostatic voltmeter capable of showing the small fall of potential across a low resistance; it is not described. The voltmeter is about 250 times as sensitive as the Mascart electrometer. He has used it to measure the voltage of telephone line currents and estimates that with the usual type of transmitter the impressed voltage on the circuit, when speaking into the transmitter in the ordinary way, is between one-fourth and one-half of a volt. This is the average voltage produced on the secondary of the transmitter coil, by singing into the transmitter a note of about the same loudness and pitch as the average voice.—Lond. *Elec. Rev.*, Jan. 26.

REFERENCE.

Alternating Current Instruments.—ALIAMET.—An illustrated description of the measuring instruments of the General Electric Company, of Berlin, noticed in the abstract of the paper of Benischke in the Digest Feb. 25, 1899.—*L'Elec.*, Jan. 6.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Faults on Telephone Circuits.—An anonymous account of some interesting faults on telephone circuits. Attention is called to the fact that one of the best forms of lightning arrester which has been fitted to telephone instruments has the disadvantage that while it prevents the instrument from being damaged by a lightning discharge, it is frequently found short circuited after a storm; this is explained. He describes a case of damage by lightning in a case in which all the wire was underground, and the ends of the wires terminated in buildings, so that the damage must have been caused by the return shock. In another case, in a telephone exchange a certain indicator frequently fell at a certain time of the day and could not be replaced for some time. It was found that in the house in which the telephone was installed, there was a leak to earth of 10-amp. when the lights in a certain room were turned on. The telephone line was a single-wire circuit with an earth return, the exchange was near the generating station, the current leaking to earth from that room found its way back to the generating station, so a portion of it followed the water pipes, to which the telephone earth wire was soldered, along the earth wire, through the instrument, line wire and indicator at the exchange, to the earth there, and then returned to the generating station.—Lond. *Elec. Rev.*, Jan. 10; reprinted in *El'ty*, Feb. 7.

Wireless Telegraphy.—LODGE.—A short abstract of a Glasgow Association lecture of a general nature. At the present time no attempt is made in practice to send messages to a particular one of several stations. There are methods by which the sending and receiving stations can be tuned so as to respond to each other, and not to another station differently tuned. The attainment of tuning, however, at present restricts the range over which such telegraphy is possible, the radiating power of an "attuned or synotic" instrument being less than the radiating power of an elevated wire, just as it is more easy to get a loud sound out of a string by using it as a whiplash and cracking it, than by stretching it on a sound board and plucking it.—Lond. *Elec. Eng.*, Jan. 26; *El'ty*, Feb. 7.

Wireless Telegraphy.—Some notes on experiments with Schaefer's system (Digest, Aug. 19) between Lavernock Point and Weston. Schaefer's system differs from that of Marconi in the receiver; instead of the coherer, a small piece of silvered glass is used, the layer of silver being divided into two partitions by means of a fine scratch. The action of this device is very vaguely said to be due to electrolysis. While the coherer closes the circuit under the action of electric rays, Schaefer's device interrupts it. The experiments have shown the action is precise; the system is to be introduced into the English telegraph service.—*South Wales Echo*; *Elek. Anz.*, Jan. 18.

REFERENCES.

Automatic Block Signal System.—An illustrated description of the system used in Lowell, Mass., to prevent collisions between turnouts on single track railways by introducing an insulated section of trolley wire at each side of the turnout, the section being automatically thrown into circuit when the track is clear. It is in use on about 14 miles of wire having 7 turnouts.—*St. R'y Jour.*, Feb. 3.

Electric Signals for Warships.—An illustrated description of an electromechanical battle order telegraph, proposed by Lieut. Comdr. Owen Schroeder, U. S. N. A dial, marked in sectors, is made to revolve behind a screen, in which one sector is cut away, a battle order being marked upon each sector. The revolution of the dial is accomplished by means of an electromagnet and a toothed wheel. The details of the mechanism are described.—*Proc. U. S. N. Inst.*, Annapolis; *Elec. Rev.*, Feb. 7.

Statistics.—A long abstract with many tables from the official report on telegraphy and telephony in Germany in 1898, with some editorial comments.—*Elek. Zeit.*, Jan. 18.

MISCELLANEOUS.

Electrical Industry in Germany.—KAISER.—A communication on the prosperity of the electrical industry in Germany. Up to the present the industry has justified the confidence of capital and has paid high and increasing dividends on the capital invested. The development of electric street railways is described and attention is called to the method of all the leading manufacturers of Germany to connect themselves with a bank or group of banks in order that they need not look for customers for their products. Instead of awaiting until companies are organized for the construction of electric railways or the erection of lighting or power plants and then entering their bids, these "double-headed electrical concerns" procure the concessions, erect the plant or build the line at their own expense, and as soon as it is in operation, form stock companies, the shares of which are kept by the banks until the success of the enterprises seems assured, when the shares are sold at a premium for the

benefit of the banks.—Editorially it is said that such a system, while doubtless of benefit to the home consumption, does not seem to greatly benefit the export business except indirectly, and that it is not likely that the system would ever gain ground in the United States. In one respect the American manufacturer is said to have little to fear from his German competitors; American goods are intrinsically better and the method adopted in this country of manufacturing all kinds and classes of articles strictly to gauge and with interchangeable parts, is little followed abroad, although some of the largest individual construction concerns in Germany are now introducing purely American methods.—*Elec. Rev.*, Feb. 7.

Electric Baths.—An illustrated description of the electromedical apparatus installed in the Alexian Brothers' Hospital in Chicago. The electric light bath is a large wooden box, the walls and top of which are lined with mirrors and studded with incandescent lamps; this bath is used for treatment of nervous diseases, Bright's disease, fatty degeneration of the heart, etc. The electric water bath consists of a heavy porcelain bathtub fitted with copper electrodes or contact plates at each end, at the sides and in the bottom; it is used for various nervous diseases; a milliamperemeter reading to 35 milliamp. is used.—*West. Elec.*, Feb. 3.

REFERENCES.

British Electrical Engineers in Switzerland.—An abstract of the report of the Swiss committee on the visit of the British Institution of Elec. Eng. to Switzerland in September, 1899, giving references to the present conditions of electrical engineering in Switzerland. The part relating to the central station of Zuerich is reprinted.—Lond. *Elec.*, Jan. 12. This report was the subject of a discussion which is abstracted in *Lightning*, Jan. 18; Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, Jan. 19.

Manufacturing Plant.—An illustrated description of the British Electric Works. Almost all the tools are motor-driven from overhead shafts.—*Lightning*, Jan. 11.

Electricity in Great Britain.—LITTLE.—A brief summary of the developments of electrical industry in Great Britain for the year 1899.—*Elec. Rev.*, Jan. 17.

New Books.

ANNUAIRE POUR L'AN, 1900. Par le Bureau des Longitudes. Paris: Gauthier-Villars. 800 pages. Paper. Price, 1 franc 50 centimes.

This well-known little pink volume is published yearly in France under an order of the National Convention of 1795. It contains a mass of astronomical, physical, chemical and sociological facts and is a very useful cross between a nautical almanac and a pocket encylopedia, brought up to date and officially promulgated. It opens this year with a page of the regular blue-book tint, marked "Important Notice," to the effect that commencing with 1900 the 24-hour method of reckoning civil time is adopted in place of the 12-hour reckoning from noon to midnight, and midnight to noon; also that the 24-hour method is being adopted by various railroads.

It is wonderful what information the book contains compressed tightly in so small a volume and compass. Everything seems to find a place, from the aberrational constant of the heavenly bodies to the number of illegitimate children born yearly in Paris. Unfortunately the book seems to have been designed to hide information as well as to record it, because in order to look through the book, one has to use a paper cutter some 400 times. The waste of time and effort required to cut 400 pages in the book that will go into a coat pocket is uncivilized, and unworthy of the year 1900. It is not only to books printed in France, however, that this criticism applies. Apart altogether from the mass of useful statistics furnished, the book is valuable for its scientific notices printed in the form of appendices. One of these is devoted to generators and electric current, by Mons. A. Cornu. This is a very elementary and historical description of the various forms of electric generators.

THE MANUFACTURE OF CARBONS FOR ELECTRIC LIGHTING AND OTHER PURPOSES. A Practical Handbook. By Francis Jehl. New York: D. Van Nostrand Co. 232 pages, 83 illus. Price, $4.00.

The European carbon manufacturers have for many years zealously guarded the secrets of their trade—a fact which in a large measure accounts for the dearth of literature on the subject of high grade carbon making. But at last "the cat has been let out of the bag" by Mr. Francis Jehl in his book just published in the *Electrician* series. Mr. Jehl's practical experience in one of the large European carbon factories puts him in a position to speak authoritatively and gives additional value to the opinions expressed and comments made.

In the preface to his book he says: "The whole object of this work is to show that high grade carbons can be made and manufactured in every country, and to dispel the idea that the art is confined solely to two or three countries of Europe."

Although the United States is the greatest electric light carbon producing country in the world, it is nevertheless a fact that to this day a large percentage of the best quality of carbons used here is imported from Europe. An American manufacturer has explained this on the ground that the cost of labor abroad is so much less than in the United States that the home industry cannot compete with the foreign in certain lines, even after the burden of a 30 per cent. duty has been imposed on the latter, to say nothing of the extra cost of transportation from the foreign market. This explanation, however, appears to fall short of the whole truth, for there is no gainsaying the fact that in some fine grades of lampblack carbons the American manufacturer has not quite mastered the art as now practiced by his German rival. The German process is the result of many years of evolution. Now that the demand for the best quality of goods has grown to large proportions in the United States, the American carbon maker will, as Mr. Jehl predicts, slowly but surely improve the quality of his product until it is equal if not superior to that of his European competitor.

A keen appreciation of the above conditions has led the author to address his book directly to the English and American manufacturers. It is doubtful, however, for reasons that will appear later on, whether the book will serve the purpose for which it is intended. Still, in any event much interesting and valuable information has been gathered by the author and presented in a systematic way.

Chapter I treats of the physical properties of carbon. Of the three allotropic forms of carbon, namely, the diamond, graphite and charcoal, the third or amorphous carbon is the only kind suitable for the manufacture of the carbon products treated of in the book.

Chapter II contains a brief historical sketch of the subject dating from Sir Humphrey Davy's experiment with the charcoal sticks in 1810. The author states that the commercial electric light carbon industry began with Carré's work in 1876. It will be noted that no mention is made of the name of Napoli, who contributed much to the development of the modern arc light carbon. The enclosed arc lamp is briefly referred to and the chapter closes with an account of Pritchard's experiments in carbon manufacture, published in 1890. In these experiments foliated graphite was used as a basic material instead of the usual lampblack or coke.

In Chapter III the author calls attention to the fact that although there are manufactured annually in the United States nearly ten times the total carbon products of all the European factories together, still about $300,000 worth of foreign high grade carbons are sold here every year in competition with American goods. He says that up to the present the American manufacturers have not been able to make as good a carbon as the imported, and adds that "no doubt the author will be able to show them where the 'bug' lies, and that they will soon be able to manufacture a carbon which will be a par with any on the market." He believes that "there is no reason why the United States with its immense petroleum wells and natural gas springs should not supply the world with all grades of carbons."

Chapter IV treats of the modern process of manufacturing carbons. The author limits his descriptions in this chapter as well as in all subsequent ones, to the system practiced in the European (Continental) factories. He states the nature and amount of raw material used in the manufacture of modern electric light carbons, with costs of each ingredient per 100 kilos, f. o. b. Vienna, Austria. He gives the amount of tar used in the raw mixture as 25 to 33 per cent., and then remarks in an offhand way that "a little experience will soon show what proportion to take." Many a carbon manufacturer will attest that that "little experience" cost him dearly. Unfortunately in this, as in many other stages of the process of carbon manufacture, no rules can be laid down, and successful results depend upon a proper appreciation and understanding of ever varying conditions met with in practice. The reviewer contends that in this case the real practical work begins where the book leaves off. The author proceeds to explain the process of manufacture starting from the storehouse that contains the raw material and going through each successive stage until the shipping department is reached. The description is profusely illustrated at each step. The illustrations show the mills for crushing, mixing and grinding the raw material; hy-

draulic presses and pumps; sorting, cutting and pointing machines; apparatus for coring. All of these are more or less familiar to the carbon manufacturer. The author then discloses the secret of the core of the German carbon, and states that the only chemical that enters into the composition of the core is "Kaliwasserglas," which is simply water-glass made from potassium carbonate. The instructions given by the author for properly proportioning the core will hardly be sufficient to quench the American worker's thirst for practical information; for again we are told that "experience will soon show how much water-glass is to be taken to a certain quantity of carbon flour."

Referring to the system of packing and carbonizing in the furnace, the *old method* of cutting the carbons into short lengths (1 foot) and baking in *periodical* furnaces is deprecated by the author, who advocates baking the rods in lengths of a yard, in *continuous* furnaces. The detailed description of the furnaces is reserved for a later chapter.

It will be noted that the chapter on the modern process of carbon manufacture covers more than one-quarter of the book, yet the *squirting* process only is described. In America the *molding* process is extensively used. A mixture that will work perfectly when squirted may not work at all when molded. The author might with advantage have enlarged considerably on this branch of the art.

In Chapter V the importance of having a well-equipped testing department is dwelt upon. It is safe to say that if the comparative tests and observations suggested by the author were made regularly by the manufacturer, the number of complaints by customers would be reduced to a minimum. Eight tests are suggested, but no reference is made to the use of the microscope in comparing different electric light carbon products. The reviewer has shown that the microscopic study of the granular structure of the carbon is of much practical use in comparative tests.

Under the caption "A new raw material" the author describes an attempt to use, as a substitute for petroleum coke, a species of coal of which large deposits are found in Bohemia. In a footnote it is stated that since having written this chapter "the author has been informed that the 'new' material and process mentioned therein has been abandoned." During a connection of several years with carbon factories in the United States, many "new" raw materials have been submitted to the reviewer for test. Some of these materials appeared promising at first, but in time a "bug" always developed. One inventor confidently believed that he had solved the problem by substituting carbonized cocoanut shell for petroleum coke, and obtained United States letters patent covering his invention.

The author gives a brief description of E. G. Acheson's method of making graphite, and predicts that this raw material will have an important place in future in carbon manufacture.

Chapter VII treats of the gas generator. In many of our American furnaces natural gas is the fuel used—in which case of course the "well" is the gas generator. But when fuel gas is manufactured, a special gas generator is necessary. The principle of such an apparatus is enunciated by the author, and different types of generators are described and illustrated.

In the preface of his book the author significantly remarks that "the *secret* of manufacturing high grade goods lies more in the process of carbonization—*that is, the furnace used*—than in anything else." In Chapter VIII he devotes one-sixth of the book to the discussion of the theory and construction of the furnace. He considers the German furnace system of Mendheim the most practical and economical. The Mendheim furnace differs from the typical American furnace in that the latter generally contains one large chamber which is charged with green carbon, fired, cooled and discharged; while the German contains many chambers, some of which may be charged and fired while others are being discharged. The German furnace referred to is therefore called *continuous*, as contrasted with the American or *periodical* furnace. Detailed drawings of the Mendheim and other furnaces including an ingenious "tunnel" furnace designed by the author, are given. The only thing that is missing in these drawings is the scale. But this omission is a very serious one if the author would have his reader make practical use of the designs submitted. A burr mill, a Jumbo press, a cutting machine, etc.—these can be bought in the market; but a furnace must be built on the ground, from which it follows that the scale measurements are all important to the carbon maker.

To prevent direct contact with the flames of the furnace during the process of carbonization, the carbons are carefully packed in fire-clay receptacles or pots, which latter are then placed in the furnace. These receptacles are used in all the German furnaces, and may be in the form of long narrow boxes or cylindrical retorts. Both types are described and illustrated by the author.

Chapter IX is devoted to the estimation of high temperatures. The Seger pyramids which are used to determine the approximate temperature of the furnace are described, and their composition given.

Chapter X treats of gas analysis. In order to obtain a check on the efficiency of conversion, the author recommends the analysis of the gas used in carbon manufacture, both at the generator before the gas enters the furnace and at the stack where it issues after its energy is spent in heating. The presence of any C O gas in the stack will show inefficient conversion and consequent loss. A very simple apparatus for making these tests is described.

Having now completed his discussion of the various apparatus used in the carbon factory proper, the author proceeds to estimate the cost of building such a works as described by him. As the prices and figures involved in his calculations are taken for conditions that exist in Austria and Hungary, the value of the estimates is naturally limited. The factory he figures on has a capacity equivalent to 39,000 ½ x 12-inch carbons per day of ten hours. The profits which he counts on reaping appear to the reviewer to be out of all proportion to what might be expected in the United States from a works of the kind and size specified. Indeed the reviewer's experience has been that such a small factory devoted exclusively to the manufacture of electric light carbons cannot be run at a profit under conditions that exist in this country.

The manufacture of electrodes on a small scale forms the subject matter of Chapter XII. An estimate is given of the approximate cost of a small plant that can produce 100 pounds of electrodes per day.

In Chapter XIII a few points in building a carbon factory are offered. The author also submits a ground plan of a model factory designed by himself, for manufacturing arc light carbons. This drawing is the only one in the book in which the scale is given.

Chapter XIV and XV are devoted to soot and soot factories. The author goes into the theory of the formation of soot or lampblack, and lays particular emphasis on the fact that the quality of the product will depend largely upon the regulation of the air supply. Here again we find that as far as the practical manufacture of soot is concerned, the book can be of but little service. The author is well aware of this himself, for he says: "Practice will soon show the amount of (air) regulation that is necessary, and it may be observed that this regulation depends upon the season of the year and the state of the weather."

The author considers the United States an ideal country for manufacturing high grade carbons for the reason that the soil is rich in natural gas and oil wells. He points out that these products of mother earth will serve for making the soot or black and the binding material as well as for heating the furnace. It remains to be proven, however, whether or not soot made from American natural gas will answer all purposes as well as German lampblack. In general the author does not appear to attach sufficient importance to the relation between quality of the carbon and character of the basic material from which the soot is made.

After describing the primitive apparatus for the production of soot, the author presents sectional drawings of the typical German soot factories. He considers the Thalwitzer machine for producing lampblack one of the most efficient used.

The book closes with a short appendix on the American method of carbon manufacture, the subject matter of which is taken from Mr. Fisk's paper read before the Canadian Electrical Association some years ago. Mr. Fisk's description will need considerable amendment to apply to the methods now in vogue in the factory of the up-to-date American carbon manufacturer.

The author notes the tendency in the United States to use finer grades of carbons than heretofore. He does not seem to be aware, however, that the extensive introduction of the enclosed arc lamp in this country during the past few years largely accounts for this. The demand for high class goods is increasing yearly.

Taken all in all, Mr. Jehl's book is well worth while reading, and should find a place in the library of every carbon manufacturer and electric light engineer. It is comparatively free from typographical errors and is admirably indexed. Here and there the author relieves the monotony of the subject by a glimpse of humor, or a well-chosen metaphor. He characterizes the alternating current arc lamp as "fidgety"—a happy expression that will appeal to all workers in this

field. Referring to the attempted use of whites of eggs as a substitute for tar in carbon making, he naively dubs the product *omelettes a la charbon.*

BOOKS RECEIVED.

SIGNALING ACROSS SPACE WITHOUT WIRES. Being a description of the Work of Hertz and His Successors. By Prof. Oliver J. Lodge, F.R.S. Third Edition. London: The Electrician Printing & Publishing Company. 133 pages, 67 illustrations. Price, $2.00.

THE AUTOMOTOR AND HORSELESS VEHICLE POCKETBOOK, 1900. By G. H. Little, C.E. London: F. King & Co., Ltd. 335 pages, illustrated. Price, 2 shillings.

Directory of Electrical Societies, Etc.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., July, 1900.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May 22, 23 and 24, 1900.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., October, 1900.

NEW YORK ELECTRICAL SOCIETY. Next meeting, Feb. 23. Lecture: "Copper from the Ore to the Wire Bar," by A. R. Ledoux.

CHICAGO ELECTRICAL ASSOCIATION. Next Meeting, March 2. Paper: "Recent Progress in the Field of Electrochemistry," by H. R. Kingman.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York. Next meeting, Feb. 28. Paper: "Notes on Electric Traction Under Steam Railway Conditions," by Edward C. Boynton.

Pittsburg Transformers.

The accompanying illustrations show the latest type of transformers manufactured by the Pittsburg Transformer Company, of Pittsburg, Pa. That represented in Fig. 1 has a capacity of 30-kw, and is wound to step-up voltage from 1100 or 2200 volts to 3300 or 4400 volts, thus being applicable to either 1100 or 2200-volt circuits. Porcelain terminal plugs within the case, as shown in Fig. 2,

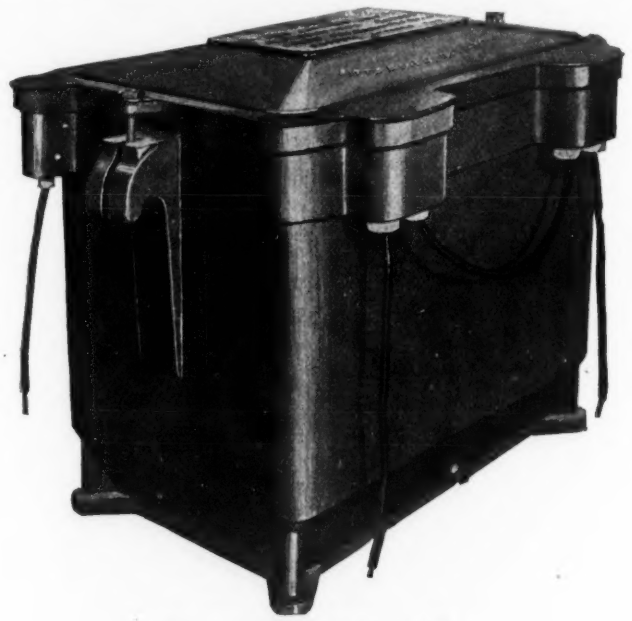


FIG. 1.—30-KW TRANSFORMER.

enable the necessary change of voltage to be made. To attain the highest practicable efficiency the windings and magnetic circuit have been proportioned to produce minimum core and copper losses, and as a consequence the transformers operate with a moderate temperature rise. This type of transformer is particularly adapted for suburban extension service.

The advantage with respect to insulation of using oil in a transformer is well shown by some experiments made by the manufacturers. Comparative breakdown tests were made with dry insulation and the same saturated with oil. In the case of bond paper, the breakdown occurred at 756 volts when the paper was dry, and at 1376 volts when the paper was saturated with oil. With a certain thickness of fibre the breakdown occurred at 1000 and 4040 volts, and for thicker plates at 1161 and 4950 volts, respectively. It will thus be seen that the insulation of the bond paper was improved 82 per cent. when saturated with oil, while the insulation of the fiber paper was improved in each case over 300 per cent. This advantage is in addition to others possessed by oil insulation, as, for example, the fact that oil flows in punctures that may be made, thereby reinsulating the same. Other advantages are the

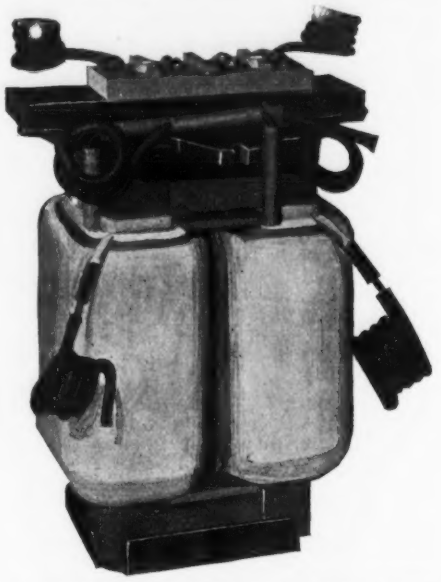


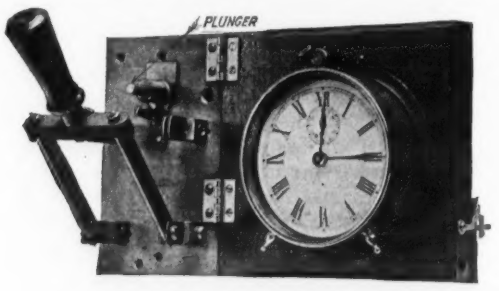
FIG. 2.—TRANSFORMER COILS READY FOR MOUNTING.

low temperature at which the oil-insulated transformer will run, and the preservative effect of the oil on the insulation.

In Fig. 2 are shown the coils of the above transformer ready for mounting in the case. In order to prevent the leakage of oil from capillary action and thus permit the use of light-bodied oils, the cables are stripped of insulation just above the oil level for a portion of about one inch in length. This part is then surrounded with melted solder so that the stranded conductors become soldered into a solid piece along which the oil cannot travel. Insulating tubes are slipped over the denuded portion of the conductor to protect the same. The oil is thus prevented from following either the insulation or passing up through the interstices of the stranded core of the cable.

Victor Automatic Cut-Out.

The apparatus illustrated herewith, which measures but 6 by 10 inches, consists of an ordinary nickel alarm clock set at the side of a standard switch, both being mounted on a neat frame. No change in the clockwork is necessary. The alarm is set for the hour when it is



AUTOMATIC TIME CUTOUT.

desired to cut out the lights; when the time arrives the alarm hammer, instead of striking the usual bell, strikes a small lever at the top of the switch; this releases a plunger which throws the switch and breaks the circuit instantly. The standard switch used is of 50 amperes capacity, but a greater number of lights may be extinguished with the same appliance by simply using a switch of greater capacity. The apparatus is made by the Vallee Brothers Electrical Company, 625 Arch Street, Philadelphia.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET was marked by advances and reactions, and by a decline in the amount of business done, while there was apparently a large increase in the loans, producing a weaker bank balance sheet. The main item of financial news in electrical circles was the announcement of a new issue of bonds for the Western Union to the amount of $10,000,000, partly to take up maturing bonds at a higher rate, and partly, through this economy, to improve the physical condition of that great property. During the week, 21,245 shares of Western Union were sold, closing at 83, a net loss for the week of 3¼. On sales of 2250 shares, General Electric closed at 127. In Traction securities, Third avenue on 107,572 shares was steadier at 106¼; on 165,745 shares, Brooklyn Rapid Transit eased off 1 to 73¼; Manhattan Elevated on 68,840 shares went up 1⅛ to 97¼, and Metropolitan Street Railway gained 5½ to 178 on 48,294 shares. In Boston, Am. Bell Telephone closed at 340, Erie at 107½; Mass. Elec. Rys. pref. 77, common 27; West End 92⅝. In Chicago, Met. Elev. pref. closed at 79½; Chicago Edison 155. In Philadelphia, Elec. Storage Battery closed at 80-80½ common, 80-81 pref.; Penn. Elec. Vehicle 7½-7⅜ common, 3½-3⅝ pref.; Gen. Elec. Automobile 4¾; Phila. Traction 98¼; Union Traction 39-39¼; Am. Rys. 4⅝; Elec. Co. of Am. 13½. In the New York outside market, Consol El. Ltg. & Equip. Co. closed at 14-15; Elec. Boat 17-19 common, 35 pref.; Elec. Vehicle 48-55 common, 70-90 pref.; N. Y. Elec Veh. Trans. 9¾-10¼; N. E. Elec. Veh. Trans. 6-6½;Illinois Elec. Veh. Trans. 2¼-2½; General Carriage 6-6½; St. Louis St. Rys. 27 common, 80 pref.

NEW WESTERN UNION BONDS.—The Western Union Telegraph Company has decided upon an issue of $20,000,000 4½ per cent. 50-year gold bonds, to be known as "Funding and Real Estate Mortgage Bonds." The immediate purpose of the issue is to make provision for the company's bonds maturing during this year and in 1902, and also to provide means for construction purposes, the demand for special wires being constantly growing. The new bonds will be specifically secured upon the real estate of the company in New York and Chicago, and will contain a provision that no mortgage shall hereafter be placed upon any part of the company's system, without first securing a prior lien to the present issue of bonds. Ten million dollars of the bonds have been sold by the company to Kuhn, Loeb & Co. The company intends to provide for the bonds maturing in 1902 out of the proceeds of the new issue. These 1902 bonds are 7 per centers and amount to $1,-163,000. Consequently, the company will refund in all about $6,-100,000 7 per cent. bonds and about $760,000 6 per cent. bonds—say $7,000,000 at a saving in fixed charges of about $165,000 annually. This saving will more than meet the interest on the remaining $3,000,000 of 4½ per cent. bonds so that there will really be no increase in fixed charges at all. The effect is that the company raises $3,000,000 additional capital for the property without increasing its present fixed charges in the least. It is expected that this new money will enable the company to cut down its operating expense by improving the physical condition of the property, thus rendering it more economical to operate.

ST. LOUIS UNITED RAILWAYS.—Brown Bros. & Co., of New York, Philadelphia, and Boston, offer to investors, by subscription, $13,625,000 of the first general mortgage 4 per cent. gold bonds of the United Railways Company of St. Louis, interest on the bonds being guaranteed by the St. Louis Transit Company, lessee. The bonds are offered for sale at 92½ and accrued interest, payable on Feb. 19, when the bonds will be ready for delivery. The total amount of the mortgage is $45,000,000, of which $14,000,-000 is reserved for underlying divisional liens, and $8,000,000 for acquisitions, betterments, and improvements, leaving $23,000,000 as the present issue, of which $9,375,000 has been sold at private sale. The United Railways Company of St. Louis controls all the street railway systems in St. Louis, except the St. Louis & Suburban system. The total mileage of the company in operation, under construction, and authorized aggregates 436.65 miles. The mortgage is directly secured by properties subject to divisional liens bearing from 5 to 7 per cent. interest, and amounting to a total of $13,980,100, of which $5,003,100 can be retired within the next two years, with an annual saving in interest of $54,623 when replaced by 4 per cent. bonds. The subscriptions closed this week.

ROCHESTER STREET RAILWAYS.—It is stated, but also denied, that a deal has been effected by which the bulk of the Rochester (N. Y.) Street Railway Company's stock has passed into the hands of representatives of Cuyler, Morgan & Co., of New York; Daniel O'Day, capitalist, of New York, and H. H. Little, lately vice-president and general manager of the Buffalo Street Railway Company, are also largely interested, it is said, and the latter is scheduled for the position of general manager of the consolidated lines. Representatives of Cuyler, Morgan & Co. went to Rochester early last month, when the street railway stock was finding few buyers at $15 to $18, and the agents picked up nearly all they wanted at $18 a share. In a few instances the holders demanded more, and in some cases, it is said, $35 was paid. Now it is declared there will be a general consolidation of all the electric lines in Western New York, and a belt line will run along Lake Ontario shores part of the distance. It is estimated that, with the trolley lines now in operation, the construction of only forty or fifty miles will be necessary.

MICHIGAN TELEPHONE STOCK.—President C. J. Glidden has served notice on the stockholders that at the annual meeting there will be submitted a proposition to increase the capital stock of the Michigan Bell Company from $2,500,000 to $10,000,000. This increase will be necessary, President Glidden says, to pay for the stock and bonds of the recently purchased Detroit and State line properties and to pay off outstanding indebtedness. The aggregate liabilities, including stocks, bonds and indebtedness, is five millions, and it is proposed to double the capital so as to have plenty of money to extend and enlarge the service. One share of the Michigan Bell Company's stock will be given for two shares of the Detroit.

ERIE TELEPHONE.—Referring to the recent increase of $5,-000,000 in its capital stock, the company announces that the underwriters have taken up 30,000 shares of the treasury stock at par, paying therefor $3,000,000 which, with the 20,000 shares already subscribed to at par by the stockholders and payable Feb. 14, will give the Erie Company $5,000,000 in cash with which to carry on their necessary extensions during the year, and entirely extinguish the floating debt of the company. The total issued capital of the Erie Company on Feb. 14 will be $10,000,000 full paid. The company disbursed for extensions during the past year about $4,-500,000, making a net gain of 43,700 subscribers and a total to-day of 111,000.

CHICAGO TELEPHONE.—Directors of the Chicago (Bell) Telephone Company have decided to issue within the present year $1,000,000 of $10,000,000 new stock recently authorized. That is the amount of money to be expended in 1900 in improvements and extending the company's plant. The stock will be offered to present holders at par in the ratio of one new share for every five now held. One-half of the new stock is to be paid for by April 5, and the other half by October 5.

Commercial Intelligence.

THE WEEK IN TRADE revealed a generally satisfactory state of affairs in all the main lines of industry in this country, and electrical lines are all getting their share. Dun's points out that the industries are still surpassing in actual output the work of any previous year. Their new business is not correspondingly large, nor could such orders be accepted by most industries if offered, but enough are coming to prevent stoppage of works or much decline in prices. Meanwhile, though encouraged by the abundance and ease of money, speculation does not in any direction as yet go without a check far enough to do mischief. There is much of the speculative spirit abroad, but also more caution than is usually shown after a year of exceptional prosperity. Perhaps the war in Africa, with its possibilities of daily surprise, is in that respect productive of good. Bradstreet's states that during January, of 107 products and staples, 36 advanced, 49 remained without change, and only 29 showed a decline. As compared with a year ago, 79 are higher. Bank clearings for the week aggregated $1,807,583,776, a gain of 18.6 per cent. over those of last week, but a decrease of nearly 1 per cent. from this week a year ago. Compared with 1897, however, the gain is 91 per cent., and the increase of 1894 is 128 per cent., while over 1892 the gain is 34 per cent. Outside of New York the gain over last week is 12.7 per cent., and over last year the increase is 4.7 per cent. Business failures in the United States for the week number 231, as compared with 171 last week, 193 in this week a year ago, 278 in 1898, 301 in 1897 and 381 in 1896. Lake copper was ¼ cent lower at 16¼, tin went up to 29¼ cents, and steel rails were firm at $35. Interest in electrical circles is caused by the announcement that the Western Union Telegraph Company has been buying copper and intends to spend a large part of its $10,000,000 raised by refunding in new construction and the general improvement of its system. There is also considerable interest in the activity of the automobile companies building the electric types. "Lead cabs" may be intended for scathing sarcasm, but

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the cabs are getting there just the same, with no competitors of any other type in sight.

AMERICAN MANUFACTURED EXPORTS.—Manufacturers in this busy country of ours in 1899 increased their importations of materials for use in manufacturing 33 per cent. over the year 1898, and actually increased their exportations of manufactures nearly 25 per cent., so that the grand total of manufactures exported during the year reached $380,000,000, and seems likely to touch the 400 million dollar line in the fiscal year which ends June 30, 1900. The exports of manufactures which in 1898 averaged 25 million dollars per month, averaged over 31 million dollars per month in 1899, or more than a million dollars for every day in the calendar year. Beginning with $25,806,870 in January, 1899, the figures grew steadily until December showed $35,652,053, December and March of 1899 showing larger exportations of manufactures than those of any preceding month in our history. Not only are the exports of manufactures in 1899 the largest in any year in our history, but they form a larger percentage of our total exports than those of any preceding year, the percentage being for the calendar year 1899 30.4 per cent., for 1898 24.9 per cent. and for 1897 25.9 per cent. Taking the entire list of classes of articles composing our imports and exports, those relating to manufactures show the largest gains both as to imports and exports. In imports, articles in a crude condition for use in domestic industries increased from $199,255,687 to $267,493,959, an increase of $68,236,322; articles of food and live animals, from $187,829,802 to $229,971,385, an increase of $42,141.583; manufactured articles read for consumption, from $104,804,809 to $118,339,856, an increase of $13,535,047; articles manufactured for use in the mechanic arts, from $59,127,686 to $75.376,005, an increase of $6,248,319, and articles of voluntary use, luxuries, etc., from $83.946,514 to $107,664,366, an increase of $23,717,852, the comparisons in each case being between 1898 and 1899. In domestic exports, manufactures increased from $307,924,994 to $380,787,891, an increase of $72,862,897; products of the mine, from $25,851,092 to $33,279,187, an increase of $7,428,095; products of the forest, from $39,030,313 to $47,562,121, an increase of $8,531,808; and miscellaneous, from $3,016,771 to $3,532,663, an increase of $515,892.

ELECTRICAL DEVELOPMENT IN CANADA.—Mr. Harlan W. Brush, United States Consul at Niagara Falls, Ont., reports as follows: Electrical industries in Canada have fully shared in the prosperity now felt throughout the Dominion. According to the *Canadian Electrical News*, the leading manufacturing and supply companies report that the volume of their business for 1899 exceeded by upwards of 75 per cent. the business done during 1898. More than half the output of these companies was applied to the extension and improvement of existing plants, the bulk of machinery sold being for lighting and power purposes. There was but little new railway construction work done during the year, but a considerable amount of apparatus was required for extensions and improvements. Improvement and development have been quite as marked in the commercial as in the mechanical field. The business done has been so large and so profitable that the stock of the two leading manufacturing companies has risen 50 points during the year, and further advances are predicted. The workshops of the electrical manufacturing companies are said to be crowded with orders to such an extent that no promise of delivery at a specified time can be made, and prices are firmly maintained. The utilization of water power for the generation of electricity has been taken up with energy throughout the Dominion. This new medium of power transmission has made possible the harnessing of Canada's almost endless water powers, and the cheapened production resulting accounts in part for the rapid growth in Canadian manufactures.

UNIFORM TERMS.—The question of "uniform terms" of payment in the electrical trade was recently brought up in this department. One of the financial and economic authorities of the electrical industry has kindly favored us with the following expression of his views on the subject: "I should say that the adoption of uniform or even definite terms of payment by the electrical trade would most certainly be of great advantage to both buyer and seller; and another step forward in this ever advancing industry. The prevailing custom is that the buyer draws up a contract stating quantity, price, time of delivery and terms of payment. When the goods are delivered, the buyer seems to consider the contract closed, ignores the payment clause or the right of the seller to enforce his part of the contract, and becomes indignant if legal interest is charged against him on the overdue account. Hence, electrical 'jug-handle contracts' are not looked upon as a very desirable security in the financial community. In my opinion, 'terms of payment' should be as specific, and adhered to as rigidly, as the price of the article, and I see no reason why this desirable condition can not be brought about if your good paper will lay the matter before its many readers." We shall be glad to have some further opinions on this important question.

NEW AUTOMOBILE COMPANY.—A special despatch from Indianapolis, of Feb. 10, says: "Local and Eastern capitalists today completed the details of an arrangement by which the second largest automobile plant in the country will be established in this city, the capital to be invested aggregating $2,000,000. The local men at the head of the enterprise are L. S. Dow, secretary and general manager of the Indiana Bicycle Company, and Arthur C. Newby, who established the Indianapolis Chain & Stamping Company. Both of these plants were absorbed by the bicycle trust and the men who managed them have induced the company to enter the automobile business." To this it may be added that Mr. Dow was recently in New York and gave out some details which confirm the above and indicate the great importance of his new departure. Not only was Mr. Dow a leading figure in the old bicycle development, but for the last year or two, in the Indiana Bicycle Company, he has been studying closely the practical evolution of the modern electric and gasoline automobile. Many of his types of vehicles are already emphatic successes, and he has not yet by any means arrived at his intended goal.

FIRST STREET CAR LINE IN CHINA.—China is now getting ready to build the first street car line ever constructed in the empire. It will not be, properly speaking, a street car line, as the streets of the cities of China are too narrow to admit of cars running through them. The first system, says the New York *Commercial*, will be between the foreign settlement of Tien-Tsin and the native city, which is three miles distant. There is no doubt that the traffic between the two towns will be large. If the Chinese take to the innovation, as it is reasonably expected they will, a belt line will be built around the city. It will be an electric trolley of the latest approved American plan and equipment. The city of Tien-Tsin has a population of about 1,000,000 people, and the foreign settlement about 15,000. The road between the two towns will be built this year, and all the rails, cars and general equipment will be bought in America. The man who promoted this enterprise and holds the franchise is, of course, a foreigner. He is an Englishman named Moller, who has resided in China for many years.

MEXICAN ELECTRIC RAILWAYS.—The electric railway system which is proposed to connect the states of Tabasco, Yucatan, Chiapas and Campeche with the Central Mexican railway system is to be called the Southern National & International Railway, and will ultimately be 409 miles long. The estimated cost is given as $14,000,000. Of this sum the Federal Government is to provide $6,000,000 and the states of Tabasco and Campeche are to be asked for subsidies. Including the Federal grant, $10,000,000 have been subscribed up to Jan. 1, 1900. The Ministry of Communications is much interested. The plans show that the road will run through the following points: Campeche, Lerma, Serva-cabesera, Sihochac, Puetunich, Sabcabchen, Chichul, Monte Clara, Palmar, Tenosique, Palenque, Tumbala, Tacotalpa, Teapa, Pichucalco, Juarez, Huimanguillo, Carmen, Moluacan, Minatitlan and Juile. The concessionaires are very enthusiastic and purpose carrying out their plans. All the stockholders in the enterprise will be Mexican citizens.

ELECTRIC LIGHTING IN GREECE.—In reply to an inquiry by the United States Export Association, of New York, Consul McGinley writes from Athens, Dec. 2, 1899: A company has recently been formed in Athens known as the Greek Electrical Company, with a capital of about $600,000, at present rate of exchange. The founders are the Bank of Athens and the Société Générale d'Enterprise. The object is the electric lighting of Athens, Piræus, Patras, Syra and Kalamata. There are 50,000 shares, at 1000 drachmas a share, but they are now selling at a premium, being quoted at 107 drachmas on the exchange of Athens. Bids can be addressed to the company direct or to G. A. Constantinides, 3 Corais Street, Athens. I have not been able to learn when the company expects to start operations. Note of this enterprise has already been made in this department.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material, from the port of New York, during the week ended Feb. 10: Argentine Republic—141 cases electrical machinery $15,221. Antwerp—4 cases electrical material material $973. British Possessions in Africa—1 case electrical material $81; 9 cases electrical material $175. British West Indies—16 cases electrical machinery $5750. Bristol—8 cases electrical machinery $2500. Brazil—74 cases electrical material $3666. British Australia—15 cases electrical material $420. Central America—2 cases electrical material $30. Ecuador—93 cases electrical material $5000. French West Indies—19 cases electrical machinery $1694. Glasgow—24 cases electrical material $1640. Hamburg—198 cases electrical material $23,900; 109 cases electrical machinery $2000. Havre—140 cases electrical material $10,125. Naples—1 case electrical material $48.

EMPIRE STATE POWER COMPANY.—Mr. E. F. Van Hoesen, C. E., formerly engineer of the Western Division New York Central, has been engaged by the Empire State Power Company, as chief engineer and superintendent, and has assumed full

charge of all construction. The company has opened business, engineering and construction offices in Amsterdam, N. Y., with a full force of engineers, draftsmen, etc., in his charge. Hon. Campbell W. Adams, for five years state engineer and surveyor, is chief of the field staff, locating large storage reservoir sites. President and General Manager J. G. Kaelber informs us that work on plant No. 3 is fairly advanced and that they expect to deliver some 2500 to 3000-hp by electricity about next April. Work on Station No. 1, with capacity for 7500-hp will be started early in the spring and the company counts on having fully 10,000-hp available by next November.

THE CLING-SURFACE MANUFACTURING COMPANY, of Buffalo, N. Y., has just been incorporated under the laws of the State of New York, retaining the same name as heretofore, with Albert B. Young as president and general manager, and Wm. D. Young, vice-president and secretary. The past year has been the most prosperous in the history of the company and the demand for Cling-Surface they report to be increasing steadily. They have now three branches, one each in Boston, New York and Chicago, with others just opening in St. Louis and New Orleans, while the well known importing house of W. J. Moxham & Co., of Sydney, Australia, has ordered a large shipment of Cling-Surface with the exclusive right to handle it in Australia. We have received from the company a large batch of illustrated testimonials.

ORDERS FOR SPRAGUE APPARATUS.—The Sprague Electric Company has equipped one of the Old Dominion Line steamers with a quantity of Lundell fans finished in white and gold to correspond with the cabin decorations. They make an attractive as well as a useful addition. The fans are mounted to run in an inverted position, the motors being attached to the ceiling. The New York Belting & Packing Company has ordered a 75-kw Sprague Company's direct-connected generator for its new factory in Passaic, N. J. The E. S. Ward & Co. has equipped its new factory in Waverly, N. J., with the Lundell apparatus, having ordered from the Sprague Electric Company one 25-kw and one 75-kw generator, belted type, of 250 volts, and fifteen motors ranging from 2 to 20-hp.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY have just received another order from London for their printing press teaser equipment—this one 50-hp, direct-connected. The order comes through the company's London agents, Bergtheil & Young, of 12 Connemara street. A 30-kw engine type generator goes to the Kingston Lumber Company, at New Orleans, and a 35-hp motor for the Gould Coupler Company, the fourth or fifth order from this concern, to be shipped to New York at once. An unusually large number of orders for smaller equipments of the 3, 5, 7 and 10-hp type of motors are under way for local concerns and houses of other cities.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, O., has just secured a nice cash order for marine equipment to go to China. The work of this company was selected in an indirect way through the high opinion entertained of similar work done for the steamer Kate Adams—a marine outfit for lighting—by experts who had some influence in placing the order for the China parties. It is to be practically a duplication of a plant on the lower Mississippi, said to be the finest marine plant on the Western waters. The Triumph Company is to furnish a generator (about 50-hp), marine type, and Sturtevant engine. The sale was effected through the Triumph Company's New York agent.

EXHIBITS IN RUSSIA.—German alarm at the American plan to transport to Moscow and there display the bulk of the United States' exhibits at the Paris Exposition is said to be likely to bring forth a counter exhibition which will be made possible by the granting of state assistance. The Russo-German Society of Berlin is perfecting plans for an iron industrial exhibition at Moscow, so that at the same time, after the Paris fair, there will be German, English and American exhibitions in the second capital of Russia. The German manufacturers of electric motors, tools, manufacturing machinery and implements will be represented.

ROEBLING WIRE SHIPMENTS.—An example of the capacity of one of the largest wire-making plants in the country is shown in the recent shipment of wire to the United States Government Station at Manila. This shipment aggregated 2200 miles of galvanized Norway iron, numbers 9 to 14 in gauge, and weighed 440,000 pounds in all. It was started in work, inspected and shipped inside of ten days; a noteworthy fact being that upon inspection not one coil failed to come up to specification. The order is directed to the Chief Signal Officer at Manila, and left on the transport Java, sailing from Jersey City, Feb. 5.

THE CREAGHEAD ENGINEERING COMPANY, Cincinnati, O., reports a good order from Spain for the Creaghead flexible bracket, ornamental type, to equip some seven or eight miles of city work in one of the larger Spanish cities. The character of the material ordered indicates that the work is to be the best throughout. In the way of domestic orders President Creaghead says business is good and increasing. One of the largest orders of the past week was for overhead brackets to equip something like ten miles of road, ordered by the Boston & Maine Railroad Company.

WESTINGHOUSE BRITISH PLANT.—It is stated from Pittsburg that Mr. Thomas Rodd, chief engineer of the Pennsylvania Steel Company, and consulting engineer of the Westinghouse interests, has left for Europe with plans for the great new plant of the British Westinghouse Company, at Manchester, England. Mr. Rodd expects to be gone six weeks, and in that time it is probable that bids for the works will be asked for from Pittsburg contractors. A contract for a $500,000 reequipment of a street railway is already in the hands of the company.

CAR LIGHTING.—Consolidated Railway Electric Lighting & Equipment sold for the first time last week at 13. The initial sale of the stock was watched with considerable interest as indicating the probable advantages to the Electric Axle Company from its merger in this company. Electric Axle is to get 67 per cent. in the new stock, and it sold last week at 4¼, so that the sale of Consolidated at 13 was about half a point below parity. Transactions, however, were limited to 100 shares. The company is getting itself in shape for a great business.

CAR LIGHTING PLANT.—It is stated that the plant of Wilcox & Howe, of Ansonia, hardware manufacturers, was sold last week to the Consolidated Railway Electric Lighting & Equipment Company, of New York city. The plant, with all the machinery, etc., has been inventoried at $110,000, and was sold for $15,000. The Consolidated Company is rapidly putting itself in shape to do a large amount of car lighting and refrigeration on the methods already described in more or less detail in the pages of this journal.

LARGE ORDERS FOR RHEOSTATS.—Mr. J. G. Hickcox, of the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., says: "Our business is steadily increasing and our output each month is larger than during the precedent month. The orders for January were the largest ever received in a single month, one order alone being for 2500-hp in rheostats. We believe that this is the largest order of the kind ever placed."

MORRIN BOILERS.—At the annual meeting of the Clonbrock Steam Boiler Company, Brooklyn, N. Y., held on Feb. 2, the following officers were elected: Thomas F. Morrin, president; A. E. Jones, vice-president; David Anderson, secretary-treasurer; and William E. Dickey, general manager. The latter gentleman succeeds Stephen Morrin, who retires. The business of this company for the past year has been exceedingly good.

TWIN CITY DIVIDEND.—At a meeting of the directors of the Twin City Rapid Transit Company last week a dividend of 1½ per cent. upon the common stock, payable Feb. 15, was declared. This is an advance of ½ per cent. over the dividend declared in August, 1899, which was the first paid by the company. President Thomas Lowry, discussing the affairs of the company, says that its condition is satisfactory in every sense of the word.

WESTINGHOUSE MOTORS IN CANADA.—The E. B. Eddy Company, of Ottawa, has awarded the contract for electric motors for operating its factories in Hull, Quebec, to Messrs. Ahearn and Soper, of Ottawa, the Canadian representatives of the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa. The contract is a large one, covering a number of motors of various sizes, all of the Tesla type.

SANTANDER, SPAIN.—"La Sociedad Electrica de Besaya" is a new company just formed at Santander, in Northern Spain, with a capital of $400,000. The company is to erect a large power plant to supply electrical energy for lighting and power purposes. The power plant is to be located fifty-five kilometers from Santander at a point where the power of the River Besaya is to be utilized. No contracts have as yet been placed.

ESTIMATES WANTED.—The Sea Bright (N. J.) Electric Light Company informs us that they are going to change their motive power from gasoline to steam, and that they desire to get estimates on the work, which will begin about April. They will furnish full details to those who desire to bid.

THE ROLLINS ENGINE COMPANY, of Nashua, N. H., report that they have now orders on hand that will keep them busy for the next nine months. They have recently shipped a large engine to Honolulu, Hawaiian Islands, to be used there for electric light service.

NASHVILLE CONSOLIDATION.—The consolidation is announced of the Nashville Street Railway, the Citizens' Rapid Transit Co., and the Nashville & Suburban Co., all of Nashville, Tenn., into one company, with $6,000,000 capital stock and $6,500,000 bonds.

ELECTRICAL WORK ABROAD.—American construction companies have been asked to bid on an electric power plant at Cuantla, Mexico; an electric power station at Rio de Janeiro, Brazil, and an electric railroad from Salonica to Langaza, Turkey.

Special Correspondence.

ENGLISH NOTES.

London Offices of ELECTRICAL WORLD AND ENGINEER, Feb. 3, 1900.

BRISTOL.—At the New Year's council meeting, at Bristol, the Electrical Committee reported that the sum necessary to be expended in making provision for the probable increase in lighting for the next few years would be about £145,000, and recommended borrowing that sum for the above purpose.

MR. R. E. B. CROMPTON, one of the best known electrical engineers in England, is at present the commanding officer of the Electrical Engineer Volunteers, and it will be interesting to our readers to know that the first detachment of this volunteer regiment has been ordered to the front, and will sail for South Africa as soon as it can be got ready. Mr. Crompton will not go with this detachment, but will probably go out a little later, and it is extremely possible that he will take with him a full equipment of search lights and other necessary electrical apparatus for service in the Transvaal.

ELECTRIC CABS.—It is a strange thing to notice in the streets of London the entire absence, at present, of electric cabs. The London Electric Company have gone into the hands of a receiver, and the project of furnishing electric cabs in London is for the present entirely inoperative. It is all the stranger, considering what electric vehicles are achieving in New York City and other cities in the United States, and many alleged excuses have been given. The chief excuse brought forward was the difficulty in educating drivers or getting drivers to propel the electric cabs, and then the batteries were blamed, but most unjustly.

D. BRUCE PEEBLES & CO., of Edinburgh, have just completed a most interesting installation of generators and motors in a large quarry in the south of Scotland, near Dumfries. The generating plant consists of two 80-hp direct-coupled sets, made by the above concern, and connected to two compound single-acting engines, made by Mirrlees, Watson & Yaryan, of Glasgow. The voltage is 500, and the current is carried two miles to the quarries, where it energizes seven 10-ton derrick cranes fitted with 15-hp Peebles motors. Six motors are also used in the stone planing and cutting shops, and several centrifugal pumps fitted with Peebles motors are also used. The whole equipment is unique in its way, and has given great satisfaction, and has proved much more economical than by using steam on the various cranes and in the various shops.

INTERIOR WIRING.—The same question that has agitated electrical engineers in the United States for years as to the proper method of interior wiring, is now attracting the attention of electrical engineers in England, and a committee appointed by the Institution of Electrical Engineers is at present occupied drawing up a set of rules and regulations. Wood casing or moulding has been general in England for years, although steel conduit, considerably lighter than what is used in the states, is now becoming very popular, and, in fact, is used almost universally. Rubber insulated wires have not proven very satfactory, and there has been quite an outcry against them, though possibly much of the trouble has been due to the joints. Higher voltages are used here, as most of the installations now carry 220-volt lamps, which, on the three-wire system, gives a voltage of about 450 volts across the outside wires, so that the question of insulation is very important.

BRITISH WESTINGHOUSE.—The following list will show the recent contracts which the British Westinghouse Company, Limited, have received, aggregating the very handsome total of 23,600-kw, divided into 16 units, besides a large quantity of smaller units, car equipments, etc. This is, of course, in addition to the large amount of work previously recorded, and which they now have on hand for various corporations. They have also just secured a contract for a 250-hp Westinghouse gas engine for the Great Western Railway, which, when installed, will be the largest gas engine in England. The list is as follows: Corporation of the City of Manchester Lighting Company, 4 1800-kw; City of London Electric Lighting Company, 2 1800-kw; City of London Electric Lighting Company, 3 1000-kw; Metropolitan Electric Supply Company, 3 1500-kw; Lighting Corporation of Glasgow, 2 1400-kw; Manchester Corporation (tramways), 2 750-kw, a total of nearly 24,000-kw.

POWER IN SWITZERLAND.—At a meeting of the Institution of Electrical Engineers, held this week, a report on the visit of the Institution to Switzerland last September was presented. Mr. R. E. B. Crompton opened a discussion and pointed out that as the water power in Switzerland was plentiful and scarce in England, the Swiss were naturally proficient in the manufacture of machinery for the electrical transmission of power, whereas English engineers, without water power and having to use coal, were rather electric light engineers. It was the condition of the country that had forced the Swiss into high-pressure alternating work and the development of the three-phase current for electric tramways. Mr. Hammond spoke of the magnificent work of the Swiss, but also pointed out that the coal bill did not represent the total cost of production. The real lesson was not so much the substitution of water for coal as the fact that the aggregation of load was the important element in low cost. Other electrical engineers took part in the discussion, which was one of great interest, and was adjourned till the next meeting of the Institution.

POWER DISTRIBUTION.—An important bill has been deposited for next session to incorporate the County of Durham Electric Power Supply Company and to empower that company to supply electrical energy in bulk within a wide-spreading district in the vicinity of Durham. The capital is £270,000, and it is proposed to erect two generating stations, one at Gateshead, on the southern bank of the River Tyne, and the other at Harraton. The bill empowers the company to enter into agreement with any local lighting authority or other body entitled to demand a supply of electrical energy for the supply of energy in bulk at such price and on such terms and conditions as may be agreed. This is one company out of a number seeking to obtain rights on a large scale for electrical purposes. Another company is seeking provisional orders for a line of towns stretching from Berwick-on-Tweed to Redruth in Cornwall. Another company is desirous of capturing the whole of South Wales, another Surrey, and another which practically covers the whole of Middlesex, Hertfordshire and Essex. A number of these companies are interwoven with one another, the directors in one company being the same in the other, and it will be interesting to watch whether they succeed in having their bills passed through Parliament.

DEATH OF PRIVATE ENTERPRISE.—It is evident to the most casual observer that there is bound to be a great fight in England between British capitalists and municipalities or "collectivism," a term which has been adopted by social economists. Municipalities are going more and more every day into all kinds of manufacturing and trading, and whereas 25 years ago it seemed natural for a city to supply its own water, and in many cases its own gas, municipal trading has now assumed a proportion that has brought down upon its advocates, representatives of almost every trade. Municipalities have gone in for printing their own stationery, doing their own binding and tailoring, having their own fitting shops, making their own gas meters, making their own ironmongery, building their own cars, and in some cases have even gone so far as to make their own bread. At the present moment it might be interesting to note that Mr. Chamberlain, whose name is now a household word the whole world over, is greatly responsible for this enormous growth, and for the popularity of municipalities. It was when Mr. Joseph Chamberlain was Mayor of Birmingham that he brought to his duties in that capacity all his brilliant qualities as a business man of great talent. The city of Birmingham, under Mr. Chamberlain, was the first to go into the trade of supplying its ratepayers with water. Since that time gas has been added to the list of municipal commodities, so that naturally when electric lighting became common it was one of the first businesses to have to resist municipalism. There is no doubt also that Mr. Chamberlain helped the local authorities during his term of office in Parliament, so that now it has become a most common thing in Great Britain for the local authorities to own the water and gas, and now they are seeking to secure possession of all the tramways. Not only has this become the case, but last year no less than 70 local authorities sought powers, not only to retain the electricity supply in their own hands, but also to engage in the manufacture of dynamos, fittings and all the necessary accessories for electric lighting. Since the municipalities began to interfere with other industries besides electric light, these industries have become interested in fighting this "collectivism," and have finally awakened to their sense of danger, and a trading committee has been formed, composed not only of electric light and electric tramway promoters, but also assisted by recruits from other trades. This Trading Committee, which has been in existence for about a year, has finally been joined by Sir John Lubbock and Mr. Henry Kimber, and has been continually carrying on a campaign through the means of the daily press and by writing to the various Chambers of Commerce, drawing attention to the danger of collectivism. The government has also been approached on the matter, and has appointed a joint committee of the Lords and Commons to inquire into the scope and limitation of municipalities, and to determine where the line should be drawn, as to what industries it is wise for municipalities to control, and which it is better to leave to private enterprise. The important political affairs of the past year have driven this matter into the background, but the trade committee has again renewed the struggle, and they hope to see the matter properly brought before the government at no very distant date.

General News.

THE TELEPHONE.

BRAINERD, MINN.—The Brainerd Telephone Exchange has been sold to Charles A. Walker.

JOHNSTOWN, N. Y.—The Glen Telephone Company has obtained a franchise to extend its lines to this place.

MUSKEGON, MICH.—The Erie Telephone Company has absorbed the Muskegon Independent Telephone Company.

BAY CITY, MICH.—The Michigan Telephone Company is making extensive improvements to its system in Bay City.

RICHMOND, KY.—Mr. T. J. Coyle, of McKee, Ky., and friends will organize a company to construct a telephone line.

BALD PRAIRIE, TEXAS.—A company has been organized to construct a telephone line from Easterly, Texas, to Bald Prairie, Texas.

ORANGE, VA.—The Orange Telephone Company will make some extensions of its lines. Mr. W. J. Crittenden is manager.

FARMVILLE, VA.—The Farmville Telephone Company contemplates extensions of its lines to several neighboring places early in the spring.

FAYETTEVILLE, N. C.—The Fayetteville Telephone Exchange has been reorganized under the name of the Carolina Telephone & Telegraph Company.

LOGANSPORT, IND.—Patrons of the telephone lines at Logansport anticipate a raise in rates as the Bell Company has secured control of the Independent Mutual plant.

FARGO, S. D.—The Minnesota & Dakota Telephone Company has incorporated, with a capital stock of $225,000. The company will have its headquarters in Minneapolis.

MARINETTE, WIS.—The Wisconsin Telephone Company has decided to rebuild the exchange in this place at a cost of $22,000. The entire system will be renewed, and all wires on the business streets will be put into cables.

SUPERIOR, WIS.—The Bell Telephone Company will shortly increase its service in this place. It is installing a new switchboard and a new system throughout, which improvements will entail an expenditure of about $50,000.

CHICAGO, ILL.—The Chicago Telephone Company has filed a certificate of increase of capital stock of the company from $5,000,000 to $15,000,000, in order to extend its system.

ERIE GAINS.—The Erie telephone system made a net gain of 3669 subscribers in January, making the total number of telephone subscribers connected Jan. 1, 110,233.

CINCINNATI, O.—The city will close a five-year contract with the Bell Telephone Company for city telephones, by which a saving of $12 per year on each instrument is made.

ONEIDA, N. Y.—The Farmers' Telephone Line between Oneida and Wataga is now an assured project. The money is being subscribed and the material will soon be purchased.

NASHVILLE, TENN.—The Cumberland Telephone Company, of Nashville, has purchased the People's Telephone Company, of New Orleans, whose capital is $600,000 and bonded debt $400,000.

MOUNT VERNON, N. Y.—The Telephone, Telegraph & Cable Company, of America, having purchased the Mount Vernon Telephone & Messenger Company, is about to rebuild the entire plant.

DES MOINES, IOWA.—The Indianola Mutual Telephone Company, of Indianola, has been incorporated. Capital, $20,000. Incorporators: J. F. Hendricks, E. B. Donnell, both of Indianola.

JOHN ADAMS, CAL.—The Independent Telephone Company expects to extend its lines in the spring. This company was recently incorporated, as announced in these columns a few weeks ago.

FARMINGTON, MO.—The Farmington Telephone Company, of Farmington, has been incorporated by Mrs. A. C. Weber, T. P. Pigg, William M. Harlan and M. P. Cayce. The capital is $5000.

ALBANY, TEXAS.—The telephone line of the Albany Telephone Company has been completed from Albany to Stamford, Texas. The line will be extended from Stamford to Haskell, Anson and Abilene.

ILION, N. Y.—The Ilion and Cedarville Telephone Company has been formed with these officers: President, Henry Champany; vice-president, George Christman; secretary, Howard Miller; treasurer, Dewitt Kelly.

TERRE HAUTE, IND.—The Citizens' Telephone Company, of Terre Haute, has been reorganized and a local exchange will be established. The company promises a rate of $30 for business houses and $18 for residences per year.

WASHINGTON, D. C.—Senator Wellington has introduced a joint resolution enlarging the powers of the United States Postal Printing Telegraph Company and authorizing the extension of its wires into the District of Columbia.

ERIE TELEPHONE.—On Jan. 31 the Erie telephone system had 110,233 subscribers and there were 4861 waiting connections, making a total of 115,094. During the month of January the system made a net gain of 3669 subscribers.

ALBANY, N. Y.—A special meeting of the stockholders of the Hudson River Telephone Company will be held in this city on March 1 for the purpose of voting upon a proposition to increase the capital stock from $2,000,000 to $3,000,000.

INDIANAPOLIS, IND.—The New Telephone Company of Indianapolis paid during the week $3000 into the Comptroller's office as half of the annual tax for the use of the streets and alleys. This tax is due in January and July of each year.

WARREN, OHIO.—The Warren-Niles Telephone Company, operating in Warren and Niles, Ohio, denies the report that its lines may be sold to a combination. The company is well pleased with its prospects, and says it is in the field to stay.

BALTIMORE, MD.—The United Telephone & Telegraph Company will soon commence operations in Baltimore, and a bill is being drafted for presentation to Congress, asking for permission to lay wires and construct subways in the city of Washington.

RICHMOND, IND.—The Home Telephone Company, which has built toll lines in every direction out of Richmond, Ind., has abandoned the completion of the New Paris, Ohio, line because the council of that town is indifferent to granting a franchise.

MINNEAPOLIS, MINN.—Three of the operators employed by the Northwestern Telephone Exchange Company here and one St. Paul operator have been discharged for, it is alleged by the officials, "talking too much" during service hours of union matters.

BOSTON, MASS.—The Hampden Automatic Telephone Company, of Springfield, Mass., was incorporated. Capital stock, $300,000. Joseph P. Herrick is the president and Samuel A. Sherwood treasurer. The company is to engage in telephone business in Springfield.

SPRINGFIELD, MASS.—The Hampden Automatic Telephone Company has petitioned for a franchise throughout the county. The company promises a yearly rate to business houses not exceeding $48, and to residences a rate not exceeding $25.

ATLANTA, GA.—The Atlanta Standard Telephone Company has filed a mortgage for $600,000 to the City Trust, Safe Deposit & Security Company, of Philadelphia, to secure bonds and to take up another mortgage of $500,000 in favor of the Atlanta Trust & Banking Company.

MINNEAPOLIS, MINN.—There is trouble here between retail druggists and the Northwestern Telephone Exchange Company over the question of allowing indiscriminate use of telephones in drug stores. The company is taking out telephones from stores that refuse to abide by its rules.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company, a new concern, which expects to run opposition to the Bell Telephone Company, reports that it has now 4500 subscriptions in the city of Pittsburg, and 814 in Allegheny. The company expects to be ready for business by the first of May.

TIFFIN, OHIO.—The Home Telephone Company held its annual meeting and elected the following officers for the ensuing year: A. L. Flack, president; A. J. Henry, vice-president; E. B. Myers, treasurer, and K. F. Briggs, secretary. The company has 681 subscribers. A dividend of 2½ per cent. was declared.

OSHKOSH, WIS.—The Wisconsin Telephone Company has secured an option on the Oshkosh Northwestern Telephone Company and the local company will be consolidated with the Wisconsin Company. Each company has about 600 subscribers in the city. The two companies will be combined in a short time.

PITTSBURG, PA.—The City Council is to be asked to grant a franchise in Allegheny to the Franklin Telephone Company. This company is said to have among its stockholders the Goulds, the Vanderbilts and P. A. Widener. The Franklin Company has lines in Millvale, Etna, Sharpsburg, Aspinwall and other towns in Allegheny County.

WHARTON, TEXAS.—A local telephone exchange has just been established here. With the completion of the gap between Wharton and Victoria, Texas, on the long distance telephone line, and the extension to Bay City, by the Southwestern Telegraph and Telephone Company, Wharton is put in direct communication with the larger cities of Texas.

BOSTON, MASS.—A few minority stockholders of the Kalamazoo City Exchange, assisted by managers of the Independent Telephone Company at Grand Rapids, attempted to prevent the sale of the property to the Erie Telephone Company. A meeting was held, but the scheme was finally abandoned, and the property will be turned over to the Erie people.

WASHINGTON, D. C.—Justice Barnard, of the District of Columbia Supreme Court, rendered a decision in a test case against the Chesapeake & Potomac Telephone Company, in which he holds that the act of Congress approved June 30, 1898, fixing a maximum of $50 per year for the use of a telephone in the District of Columbia, is unconstitutional.

SAN ANTONIO, TEXAS.—The city council has granted to H. M. Aubrey and Frank C. Smith, of this city, a twenty-five year franchise for the establishment of an independent telephone company. The new system must be in operation within eighteen months and its maximum charges are fixed at $3 per month for business telephones and $2 per month for residence telephones.

ELWOOD, IND.—The Elwood Telephone Company has quit business, leaving the field to its more powerful competitor. The Elwood exchange was established because of the high rates charged by the Bell Company, and at one time had 400 subscribers. It is claimed that the patrons most active in the organization of this company were the first to go over to the Bell Company.

NEWARK, N. J.—The following named gentlemen have been elected officers of the Newark Telephone Company: President, John M. Gwinnell; treasurer, Charles B. Smith; secretary, A. Norton Taylor. Directors—John M. Gwinnell, Clement I. Walker, H. M. Cross, Edward W. Jones, A. L. Angle, James B. Curtis, Henry C. Vance, Augustus Woodruff, A. W. Deas, Caleb H. Barney and Charles B. Smith.

SAN ANTONIO, TEXAS.—The city council granted to H. M. Aubrey and Frank C. Smith, of this city, a twenty-five year franchise for the establishment of a telephone company to operate in competition with the Southwestern Telegraph & Telephone Company. The new concern is pledged to begin operations within eighteen months, and its maximum charges will be $3 per month for business and $2 per month for residence telephones.

PITTSBURG, PA.—It is stated that the United Telephone & Telegraph Company, an independent telephone company now constructing exchanges in Pittsburg and Baltimore, is not connected with the Telephone, Telegraph & Cable Company of America. At the present time the company has constructed 14 miles of subways in Pittsburg, and has more than 4000 subscribers. It is also erecting a central exchange, which will cost $100,000.

MILWAUKEE, WIS.—Grand Rapids and Centralia have one of the best telephone exchanges in the Northwest. It is operated on the co-operative plan. The rates are $1.50 per month for business places, and 25 cents per month for residences, to all stockholders, and $2.25 for business places and one dollar for residences to the public. Twelve per cent. per annum is paid on all stock. The company is preparing to change next spring to metallic service.

GALATIA, ILL.—The Saline County Telephone Company, which was recently incorporated, has been completely organized, and the following named officers were elected: M. D. Empsen, president; C. V. Parker, secretary; T. E. Webber, treasurer, and Charles Le Tempt, general manager. The company has 25 miles of toll lines at present, and will have 75 miles more. Its rates are $1.00 for residences; $1.50 for city business; $1.25 for farms; 25c. for toll service.

FERGUS FALLS, MINN.—F. G. Barrows and Robert Hannagh, of Fergus Falls, Minn., have recently purchased an interest in the Forman Telephone Company, Mr. Barrows being elected president and Mr. Hannah secretary and treasurer. They are president and secretary respectively of the Fergus Telephone Company, and the new arrangement gives them the complete management of the Forman company's properties also. These properties include the exchanges in various places and about 150 miles of toll lines.

CLEVELAND, OHIO.—The Central Union Telephone Company is improving its exchanges in several Ohio towns. At Springfield a new central station has just been built, and a new exchange with the common battery system is being installed. These improvements will probably cost $160,000. At Painesville, the common battery system is to be installed in the near future. Four new switchboards, with 100 drops each, will be required, and there will be a toll board for outlying towns. Two new lines will be built to Cleveland. The common battery system has also been installed at Ashtabula and Sydney.

NEW HAVEN, CONN.—At the annual meeting of the Southern New England Telephone Company the directors of last year were re-elected. The directors re-elected the old officers, as follows: President, Morris F. Tyler; vice-president, James E. English; secretary and treasurer, A. H. Ember. The annual statement shows gross receipts of $689,005, expenses $525,949, including fixed charges of $35,000. The net earnings were $163,510. Dividends declared amounted to $150,660, leaving a surplus of $12,850. The number of stations in the state on December 31, 1899, were 12,697, an increase of 2108 over the previous year. The company's wires now reach 157 out of 168 towns in the state. The policy of putting wires underground will be pursued.

ELECTRIC LIGHT AND POWER.

MONTEZUMA, IOWA.—There is a movement on foot at Chelsea for an electric light plant.

DOUGLAS, GA.—The mayor of this place can give information regarding the proposed city electric light plant.

STUTTGART, ARK.—The Stuttgart Water and Electric Light Company has completed its electric lighting plant.

CITY OF MEXICO, MEX.—An electric light and power plant has just been installed in the large La Concordia Cotton Factory.

KEYSER, W. VA.—The Keyser Electric Light Company has just installed new equipment, including dynamo, engine, boilers, etc.

FRANKFORT, IND.—Morris M. Defrees, of Indianapolis, has been awarded the contract to build a new electric light plant at Frankfort.

BELLAIRE, OHIO.—The electric plant of the Bellaire Steel Works was destroyed by fire on January 30, entailing a loss of $100,000.

STEWARTSTOWN, PA.—A new electric light and power plant will be erected here, plans for which are now in course of preparation.

SYRACUSE, N. Y.—The voters of this city are to vote on the subject of municipal ownership of the electric lighting system of this city.

OWENSBORO, KY.—An electric light plant will be established here by the city at a cost of $40,000. For further information address the mayor.

SAG HARBOR, N. Y.—Work was commenced on the Sag Harbor electric light plant, and the foundation for the power house is now being laid.

DULUTH, MINN.—The Commercial Light & Power Company has made a proposition to light the city at the rate of $50.62 per lamp.

ABBEVILLE, LA.—Mr. W. H. Waggoner and associates will build an electric light plant in this place. A company will be formed for the purpose.

TARBORO, N. C.—An electric light plant will be built by this city. Mr. J. A. Weddell, Secretary of Public Works, can give further information.

MARION, IND.—The Marion Electric Light & Power Company is preparing to adopt the meter system. All patrons to be charged at the rate of 10 cents per kw.

JENNINGS, LA.—Mr. R. S. Sterns of this place, having obtained a franchise for an electric light plant, will form a company. The company will need new equipment.

GRAYSON, KY.—A vote will be taken here on the proposition of issuing $3000 in bonds for an electric light plant. Further information can be obtained from the town clerk.

WINONA, MISS.—A company will be organized here with a capital stock of $25,000 for the erection of an electric light plant. Mr. Charles Morser and J. C. Wadsworth are interested in the project.

RALEIGH, N. C.—The Kinston Electric Light Company has been incorporated at Kinston. Capital, $10,000. Incorporators: B. W. Cannady, J. H. Abbott, J. W. Grainger, L. Harvey, all of Kinston.

MT. PLEASANT, TENN.—The Mount Pleasant Electric Company has been incorporated. Capital, $15,000. Incorporators: E. L. Gregory, O. Ingram, J. G. Ingram, H. D. Rahm, J. Rahm, all of Nashville.

EVANSVILLE, IND.—The People's Electric Light & Power Company has given notice that it will close up its business on March 1. The Evansville Gas & Electric Light Company will then have the field all to itself.

ELWOOD, IND.—The plate glass factory at Elwood is being equipped with an electric light plant, and will enter into competition with the electric company now supplying the city, which is charging $85 per light.

COLORADO, TEXAS.—The Colorado Electric Light Company of Colorado, Mitchell County, has been incorporated. Capital stock, $10,000. Incorporators: Benjamin S. Vantuyl, Thos. B. Vantuyl and Robert M. Webb.

DAYTON, OHIO.—The Citizens' Electric Light, Power & Heating Company of this city has been incorporated. Capital, $200,000. Incorporators: W. T. Block, G. G. Luthy, W. Craighead, J. W. Kreitzer, S. D. Bear.

DALTON, GA.—It is proposed to erect an electric light plant in this city by the municipality and a committee has been appointed to obtain information on the subject. Mr. J. M. Sanders is chairman of the committee.

ATLANTA, GA.—The Georgia Electric Light Company has awarded to G. N. Gest, Springfield, Ohio, the contract for the construction of underground conduits in this city. The work will cost in the neighborhood of $100,000.

SAN FRANCISCO, CAL.—Mr. W. F. Waterhouse, who was once connected with the Westinghouse Electric & Manufacturing Company, is now at the head of the San Francisco Gas & Electric Company's electrical department.

WILMINGTON, DEL.—A franchise has been granted to the Universal Conduit, Light, Heat & Power Company to lay conduits, erect poles, string wires in this city. The company was chartered last May. It has a capital of $300,000.

SACRAMENTO, CAL.—The San Pedro Terminal Gas, Electric & Power Company, of Los Angeles, has been incorporated. Capital, $100,000. Incorporators: F. H. Rindge, of Santa Monica; H. V. Carter, G. I. Cochran, W. Gilleden, L. A. Phillips, all of Los Angeles; W. J. Williams, W. W. Beckett, J. R. Haynes, all of Pasadena.

TORONTO, ONT.—Mr. W. T. Stewart, electrical engineer, has submitted to the fire and light committee of the city council a report showing the cost of a municipal electric light plant for the city, and advocating that it be installed.

CHICAGO, ILL.—Five thousand of the 85,000 gas lights in the city have been put out of use by City Electrician Ellicott and will not be used again until the appropriation bill is passed and the amount to be used for gas lighting determined.

WASHINGTON, D. C.—It is the purpose of the Potomac Electric Power Company to begin at an early date the enlargement of the steam electric plant in Georgetown. It is proposed to increase the plant by putting in two 3000-hp machines.

NEWPORT NEWS, VA.—The Consumers' Light, Heat & Ice Company has been organized here. Mr. W. C. Stuart is president, R. W. Perkins vice-president, J. A. Hirshberg secretary, and Elias Keyser treasurer. The capital stock is $100,000.

HAMILTON, ONT.—Mr. Edward Irwin, electrician of Hamilton, Ont., is said to be preparing plans for the St. Andrew's Falls Power Company, of Winnipeg, Man., which purposes developing 3000-hp from a fall about 17 miles from this city.

ATLANTIC CITY, N. J.—It is reported that the Delaware River and Atlantic Trolley Company has secured the old Colwell mill property, with the water power rights, at Weymouth, Atlantic County, where it proposes locating a power plant.

WORCESTER, MASS.—The Worcester Electric Light Company has petitioned the Gas and Electric Light Commission for authority to issue $100,000 additional capital stock, the proceeds to be used in putting its wires underground and enlarging its plant.

BRANDON, MANITOBA.—The Brandon Electric Light Company is considering a proposal to utilize the water power of the Little Saskatchewan River, which flows into the Assiniboine, about eight miles west of here. The manager of the company is George Paterson.

ALBANY, N. Y.—A bill has been introduced in the Senate incorporating the Lockport and Newfane Power & Water Supply Company, with a capital of $500,000. Willard T. Ransom, Henry I. Pierce, John A. Merritt and Harry L. Ransom are named as incorporators.

VANCOUVER, B. C.—Mr. James Ferguson, of New York, is in Vancouver, forwarding a scheme for bringing electric power for manufacturing purposes from Slave River, a distance of about twenty miles from Vancouver. An American company proposes to expend $200,000 in the erection of a plant.

PACHUCA, MEXICO.—Mr. Alexander Vivian, who was employed as electrician of the electric light plant of the City of Pachuca for over two years, has accepted a position with the electric power company of this city. He has been succeeded by Mr. William Honey as electrician of the electric light plant.

RICHMOND, IND.—The council committee on electric lights has selected a site for a power-house, and plans are being drawn. The idea is to establish a commercial lighting plant at once, and when the street lighting contract with the local company expires, two years hence, to be in readiness to furnish the entire city service.

DARTMOUTH, N. S.—The city of Dartmouth, Nova Scotia, will ask the Provincial legislature for authority to borrow $40,000 to provide that city with an electric light plant to be operated under municipal ownership and control. An engineer will be engaged to report on the water power available at Port Wallace Locks.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company elected the following directory at the annual meeting: Joseph B. Crockett, Peter Donahue, Adam Grant, Charles E. Green, J. Downey Harvey, Daniel T. Murphy, George W. Prescott, A. H. Payson, Levi Strauss, Thomas B. Bishop and William F. Whittier.

AUGUSTA, GA.—Southern capitalists are organizing a company for the purpose of buying and erecting electric light plants throughout the South. Options on several plants have been secured. The company's capital is $10,000,000. Mr. J. L. Wrenn, of New York, is president and Mr. J. M. Wood, Wilmington, N. C, manager and purchasing agent.

SAN FRANCISCO, CAL.—The Ratcliff Consolidated Gold Mines, Limited, situated in Inyo County, Cal., are to be operated by an electric transmission plant, which will be installed 12 miles from the works. The estimated cost is $50,000. Mr. O. O. Howard, Jr., who is president of the company, is going East to receive bids for the machinery.

ALBANY, N. Y.—The Roslyn Light, Heat & Power Company, of Roslyn, Nassau County, has been incorporated, with a capital stock of $50,000, to furnish electricity in the towns of North Hempstead, Oyster Bay and Hempstead, Nassau County. The directors are C. H. Mackay, of Roslyn; R. D. Winthrop, of Westbury, and E. D. Morgan, of Newport, R. I.

YOUNGSTOWN, OHIO.—The Merchants' Light, Heat & Power Company, of Youngstown, Ohio, was incorporated last week, with a capital stock of $55,000 by Henry F. Kaercher, David F. Anderson, George E. McNab, William R. Beard, and Paul C. Kaercher. The company has secured an electric light franchise in Youngstown. A new plant has been started, and a contract for $40,000 worth of equipment has been placed.

NIAGARA FALLS, N. Y.—It is understood that the commissioners of Victoria Free Park and the Ontario Power Company have come to an agreement relative to the proposed development of power on the Canadian side of the Niagara River by the Ontario Power Company. The plans of the company call for diverting water from the Welland River about two miles back from the falls, and by means of a canal carry this water to the bluff in the rear of Victoria Park.

MILVILLE, N. D.—W. I. Gray & Co., of Minneapolis have taken the whole contract for the municipal electric light and water works plant and sublet that of the water works and steam plant. The electrical equipment will consist of a 60-kw 2000-volt Warren alternator and marble switchboard. Enclosed arcs and 32-cp incandescents with Cutter street hoods will be used for street lighting. The alternator will be belted to a Twin City Corliss engine, which is also to run a triplex power pump. The cost of the plant is $26,000.

RICHMOND, VA.—The William R. Trigg Company will probably adopt electricity entirely as motive power. Two weeks ago they let contracts for some $35,000 worth of new shipbuilding machinery, all of it to be motor driven, and last week contracts were let for more such machinery. It is understood

that they have made a contract with the Virginia Electrical Railway & Development Company, who are developing the water power of the James River, to furnish them all the electric current they may wish, to the extent of 600-hp.

PHILADELPHIA, PA.—At the annual meeting of the Pennsylvania Manufacturing, Light & Power Company yesterday Jeremiah J. Sullivan, Charles A. Porter, Joseph B. McCall, A. V. R. Coe and J. Morton Fultz were elected members of the Board of Directors. The report of the treasurer shows an income from all companies of $1,121,650. After payment of fixed charges and interest on the old Philadelphia Electric 5 per cent. bonds and dividends on stocks there is shown a surplus of $58,473. The Board of Directors will organize by electing Mr. McCall president, Mr. Fultz vice-president and Mr. Coe secretary and treasurer.

THE ELECTRIC RAILWAY.

CHICAGO, ILL.—The South Side Elevated Railway Company has ordered 30 new coaches.

ROANOKE, VA.—The Roanoke Railway & Electric Company contemplates several extensions to its system in this city.

BELLEVILLE, ILL.—The St. Louis & Southwestern Electric Railway Company has applied for a franchise in this place.

SIOUX CITY, IOWA.—The Sioux City Traction Company will expend $100,000 in improvements on the plant this year.

PITTSBURG, PA.—The Pittsburg Southern Street Railway Company has been incorporated, with a capital stock of $25,000.

BENNINGTON, VT.—The Bennington & Hoosac Valley Electric Railway Company of Bennington will erect a new power house at once.

DALLAS, TEX.—The construction of ten miles of street railway in the city and suburbs is under consideration by John H. Carter and others.

NASHVILLE, TENN.—The Nashville Railway has filed a supplemental acceptance to the ordinance consolidating the street railways of this city.

HARTFORD, CONN.—Surveyors are laying out the route for the new electric railway to be constructed this spring from East Haven to Branford.

DETROIT, MICH.—The Township Boards of Ypsilanti and Pittsfield have signed the franchises for the Belleville, Ypsilanti & Ann Arbor electric road.

WARSAW, IND.—Six well known Warsaw business men have acquired a franchise for an electric road through Kosciusko County from Syracuse to Warsaw.

CHATTANOOGA, TENN.—The residents of Sherman Heights, a suburb of this city, desire to have the present street railway system extended to that part of the city.

TOLEDO, OHIO.—The Toledo, Bowling Green & Fremont Electric Railway Company has let a contract for the erection of a large car barn and repair shop.

INDIANAPOLIS, IND.—The Indianapolis Street Railway Company is building 100 new summer cars. Each will be 33 feet 11 inches long, and seat 36 passengers.

BAY CITY, MICH.—The contract for the erection of the new power house of the Consolidated Railway Company has been awarded to the Bay City Stone Company.

ST. LOUIS, MO.—A building permit was issued to the St. Louis Transit Company for the construction of a new power house here. The structure is to cost $200,000.

TERRE HAUTE, IND.—The electric railway extending from Terre Haute to Brazil, now almost completed, has been sold to the Terre Haute Electric Railway Company.

ALLIANCE, OHIO.—The Alliance, Salem & Sebring Electric Railway Company has decided to build the portion of the line between Alliance and Salem the coming spring.

BELMONT, MASS.—The Boston Elevated Street Railway Company has petitioned the selectmen for a location on Concord Avenue. A hearing will be given in a few weeks.

INDIANAPOLIS, IND.—The Union Traction Company has let contracts for building the sub-power houses at Marion, Dalesville, Fairmount, Elwood, Alexandria, Ingalls and Lawrence.

IRVINE, KY.—The Irvine Land, Loan & Investment Company has secured a franchise to build a street railway in this place. No contracts have as yet been let. Mr. W. O. Riddell is secretary.

TOLEDO, OHIO.—The Toledo & Maumee Valley Traction Company has about decided to make use of a franchise secured some time ago and extend its line from Maumee to Waterville.

YORK, PA.—The York Traction Company has been incorporated. Capital, $100,000. Incorporators: W. H. Lanius, G. Hersh, W. F. B. Stewart, G. S. Millmeyer, J. W. Steacey, all of York.

HAMILTON, O.—Mr. Ira H. Milliken, formerly general manager of the Hamilton & Lindenwald Electric Transit Company, has asked for the appointment of a receiver for that company's property.

GLENS FALLS, N. Y.—The Saratoga & Northern Railway, which was to build a trolley line from Saratoga to Glens Falls, has been dissolved. Joseph A. Powers has been appointed temporary receiver.

BAKERSFIELD, CAL.—The City Improvement Company, of this city, has commenced the building of an electric railway to Kern City. Power will be obtained from the plant in Kern River Canyon.

HEMPSTEAD, L. I.—The village of Hempstead has granted a franchise to the Mineola, Hempstead & Freeport Traction Company for the right of way through the corporate limits of Hempstead Village.

ROCHESTER, N. Y.—It is proposed to merge the Rochester & Irondequoit and the Rochester & Lake Ontario Railroad Companies into one corporation and to run the road to the Sea Breeze by electricity.

MOUNT PLEASANT, PA.—The Borough Council has granted the Connellsville & Uniontown Electric Railway Company a right of way through the borough. The company will pay $2000 for the privilege.

TAMPA, FLA.—The Tampa Electric Light Company has issued a $500,000 mortgage to secure a bond for a like amount. A portion of this amount will be expended in extending the present street railway system.

WILMINGTON, DEL.—Peter J. Ford is reported to have acquired control of the Wilmington City Railway Company, which is now owned by the United Power and Transportation Company, of Philadelphia.

LOS ANGELES, CAL.—It is proposed to equip the Cummings street railway with electric power, and there is a possibility of extending the line. Ex-Mayor William H. Workman, of Los Angeles, is the proprietor of the road.

INDIANAPOLIS, IND.—The Pennsylvania and Big Four Railway Companies are preparing to introduce motor cars on their lines out from Indianapolis, and will run suburban trains in competition with the electric roads.

COLUMBUS, OHIO.—The Zanesville, Adamsville & Coshocton Electric Railway Company has been incorporated by Jonathan B. Wilson, William O. Littick, Edgar C. Jordon, Howard E. Becker and F. H. Southard. The capital is $10,000.

TOLEDO, OHIO.—The Toledo, Fremont & Norwalk Electric Railway Company has abandoned the plan of securing a right of way through the main streets of Bellevue, and has announced its intention of passing south of the town.

NEW HAVEN, CONN.—A trolley road is to be constructed between Willimantic and Baltic, connecting at the latter place with the Norwich street railway system, and thus connecting Willimantic and Norwich, a distance of 16 miles.

YOUNGSTOWN, OHIO.—The Youngstown & Sharon Street Railway Company, a corporation recently organized, is at work securing franchises through Sharpsville, Sharon, Hubbard and Youngstown. A portion of the right of way has been granted.

WILMINGTON, DEL.—A movement is in progress to incorporate a trolley line to run from the Delaware boundary line to the Susquehanna River, crossing Cecil County. John S. Rossell of this city has been asked to become one of the incorporators.

LIMA, OHIO.—J. D. Adkins, representing the proposed Lima, Toledo & Cincinnati Electric Railway, has withdrawn the application for a franchise along the Perrysburg pike. Operations to be commenced at once on another route through the county.

READING, PA.—The United Power & Transportation Company is to erect new shops at Reading, including brass foundry and machine plant. The same company is reported to have bought the Norristown lines of the Schuylkill Valley Traction Company.

NEW YORK, N. Y.—Application was made to the Municipal Council for a franchise for a system of tunnels connecting the Boroughs of Manhattan and Brooklyn, to be constructed and operated by the New York and Brooklyn Union Transportation Company.

PITTSBURG, PA.—The Consolidated Traction Company of this city is now placing the poles and laying the track for an extension of its line from Etna to De Haven. This is a link in the line which will eventually connect Pittsburg with Butler, a distance of 45 miles.

INDIANAPOLIS, IND.—A bill will be introduced in the next Indiana legislature providing that every franchise granted by a municipal corporation for the use of public property shall first have to be ratified by a majority of the legal voters of the municipality granting the franchise, at a special election.

MADISON, IND.—The projected electric railway from Madison to Indianapolis will pass through several towns that have no railway facilities, and the people of these places are anxious to have the road constructed. Every inducement for the speedy organization and construction of the line is being made.

BUCYRUS, OHIO.—The Ohio Central Traction Company is considering the project of building an extensive belt line in Crawford County. The eastern terminus of its road is now at Bucyrus, and it is proposed to make a belt to Crestline, Leesville, Liberty, Tiro, New Washington, Sulphur Springs and back to Bucyrus.

PITTSBURG, PA.—The Pittsburg street car companies have just paid their taxes to the city. The law here is that the companies pay $60.00 a year for each car operated by them within the city limits and $30.00 per year for each car operated within and without the city. The total amount of taxes received so far has been $17,405.53.

WASHINGTON, D. C.—The annual report of the Capital Traction Company for 1899 shows a balance of $35,547.80, after deducting all expenses. The company has a funded debt of $1,000,000 and a floating debt of $80,000. The number of passengers carried in 1899 was 25,199,325.

GALVESTON, TEX.—The Galveston City Railroad, comprising forty-one miles of electric tramway, has been sold under foreclosure for $905,000 to Chas. E. Hotchkiss, representing the Guaranty Trust Company, of New York, and the Reorganization Committee. The road controls and operates the Gulf City Railway & Real Estate Company. The receiver was appointed in July, 1897.

NEW YORK, N. Y.—The Citizens' Relief Committee of Brooklyn have prepared a bill to be introduced at Albany providing for a five-cent fare for one continuous ride; transfers to be given upon demand without charge; any infraction of this law to be a misdemeanor. This bill is intended to enforce the recommendations of the State Railway Commission, which, in these respects, it is stated, have been ignored.

FORT WORTH, TEXAS.—Mr. J. T. Voss, president of the Polytechnic Street Car Company, of Fort Worth, and Mr. Van Ginkle, owner of the Consolidated Street Railway System of Dallas, who have formed an arrangement to build an electric railway between Fort Worth and Dallas, a distance of 35 miles, are now in New York completing the details for the immediate construction of the line.

NEW YORK, N. Y.—The property of the New Paltz & Wallkill Valley Railroad Company has been sold to the New Paltz & Poughkeepsie Traction Company. The following named officers have been appointed: William L. Supplee, president; E. C. M. Rand, vice-president; Charles H. Stout, secretary and treasurer; Charles C. Southard, general manager. Mr. Southard's address is 164 Montague Street, Brooklyn.

BELVIDERE, N. J.—The Warren County Traction Company has been incorporated to build trolley lines in Warren County. The capital is $250,000. The incorporators are Howard Mutchler, Easton; Morris M. Reading, Phillipsburg; Robert A. Montgomery, Lambertville; Charles L. Hemmingway, Easton; Richard B. Reading, Lambertville; William S. Pretsel, Phillipsburg; Frederick Frelinghuysen Kennedy, Bloomsburg.

NEW YORK, N. Y.—Comptroller Coler stated that he intended to impose the full penalty allowed by law on street railway corporations which had not paid their car license fees or percentages of fees promptly. The Metropolitan Street Railway Company, he says, owes $28,646.65 in penalties. The total due to the city for percentages and fees is $197,218.45, making the total bill which the city has against the Metropolitan $225,865.10.

MANCHESTER, MO.—The County Court of St. Louis County has granted a fifty-year franchise to the St. Louis County Transit Company, to build and operate an electric railroad from St. Louis to Manchester, a distance of 19 miles. The company is incorporated with a capital of $140,000. The principal promoters are G. Phil Hofmann, president; J. H. Busch, J. H. Williams, George Hofmann, and Charles A. Nill, all of St. Louis.

ANDERSON, IND.—Messrs. Eshelman & Kaufman, contractors, of Anderson, were awarded the contract by the Union Traction Company for the building of eight electric sub-power stations, to be erected at Muncie, Marion, Elwood, Daleville, Fairmount, Alexander, Ingalls, and Lawrence. The contract price is $35,400. The power will come from the main power house, to be erected in Anderson, the contract for which was let recently.

OTTAWA, ONT.—The Ottawa Electric Railway Company in 1899 carried 5,833,829 passengers over its road, an increase of 700,000 over the previous year. The net profit was $85,280. The Britannia extension, some eight miles distant from Ottawa and running out of the city, is expected to be in operation by the first of May next. The weight of the rails on this extension is 72 pounds per yard, and the construction and equipment is of the highest class.

COLUMBUS, OHIO.—The Columbus, London & Springfield Railway was incorporated by John G. Webb, John M. Good, Hart F. Fisher, Emmet Tompkins and Fletcher S. Penfield, with a capital stock of $1,000,000. The company, besides operating a passenger and freight electric road, will have its own telegraph service, and will furnish electricity for power, light and heating to the towns along the route. It is intended to make the service equal to steam roads.

PITTSBURG, PA.—Theophilus Sproull, of this city, has held a conference with a number of the officials of the Akron & Cleveland Electric Railway Company on behalf of a syndicate of local capitalists to close up the final arrangements for the construction of an electric railway line between Pittsburg and Cleveland, a distance of about 150 miles. The meeting lasted for several hours, but no definite understanding was reached. Another meeting will be held in a few days.

OTTAWA, ONT.—The San Paulo Tramway, San Paulo, Brazil, an old mule road, is being changed over to electric power. The new electric system will have 40 miles of track, of which 15 miles have been laid down to the present time, and the equipment for poles and cars is already on the spot. Water power to the extent of 18,000-hp will be obtainable, some 10,000-hp being now in process of development by a Canadian company. The hydraulic works, which are said to be exceedingly well situated, are located about 18 miles from the city of San Paulo.

BOSTON, MASS.—A petition was presented to the Railroad Commissioners asking for permission to unite the Lynn & Boston and the two combinations already consummated, embraced in the Wakefield & Stoneham and the Gloucester groups, 13 in all. The Railroad Commissioners issued an order permitting the consolidation of these companies: The Brockton; Taunton & Brockton; Brockton, Bridgewater & Taunton; Boston, Milton & Brockton, and the Brockton & East Bridgewater. The companies were acquired by the Brockton Street Railway, and the capital stock increased from $750,000 to $1,245,000.

BUFFALO, N. Y.—A street railway deal, involving the principal trolley lines of Western New York, backed by the Cuyler-Morgan Syndicate of New York, is said to be under way. A despatch from Rochester states that this report is "laughed at" there. It is said that a trolley line from Rochester to Buffalo could be operated by Niagara Falls power. It is understood that a line will be built from Rochester to Buffalo along the shore line of Lake Ontario, making use of some of the short lines now in existence. The line will tap the International Company's system, which operates all the trolleys in and between Buffalo, Niagara Falls, Lockport and intermediate cities.

OTTAWA, ONT.—Mr. F. B. Brothers, manager of construction of the Demarara Electric Company, Demarara, British Guiana, has returned here to purchase, rails, cars, etc. The Montreal capitalists who have purchased the old Georgetown tramway as well as the electric light system will at once change the former to an electric system. Some 12 or 15 miles of track will be laid down in the city of Georgetown, which has a population of about 70,000, and the company expects to make very considerable extensions later on. Mr. Brothers stated that as soon as the requisite rails and other material were received from Canada, the entire work would be rapidly pushed forward to completion.

THE AUTOMOBILE.

THE AMESBURY AUTOMOBILE COMPANY, Amesbury, Mass., reports that it will do nothing just at present toward the marketing of the Bagley electric automobile. It is waiting further developments in the electrical line.

AUTOMOBILES IN CEMETERIES.—The Directors of the Forest Hill Cemetery, Boston, Mass., will not permit automobiles inside the cemetery on account of the alleged risk of frightening horses and causing a panic in funeral processions.

AUTOMOBILES IN PATERSON.—The Board of Aldermen of Paterson, N. J., has granted a franchise to the Union Transit Company to establish a line of automobiles in the city's principal streets, the company to pay the city 2½ per cent. of the gross receipts.

AUTOMOBILE ORDINANCES.—The Brookline, Mass., Selectmen have passed a set of rules for automobiles. The speed is limited to ten miles an hour, public vehicles must be licensed and carry a number on the rear of the carriage, and persons in charge of automobiles must obey the directions of the police as to where to stand while waiting for passengers.

NEW YORK CITY.—The New York Electric Vehicle Transportation Company is opening this week at Forty-fifth Street and Fifth Avenue, a fine salesroom and showroom. It will be 70 feet deep by 23 feet wide, with full facilities. The Transportation Company will move at once to the new address, 541 Fifth Avenue, its offices now being located at 100 Broadway.

MILWAUKEE, WIS.—The Wood Electric Vehicle Company of Wisconsin has been incorporated by Frank R. Bacon, R. B. Mallory, N. S. Hopkins and F. L. Pierce, of Milwaukee, for the purpose of introducing automobiles throughout Wisconsin. A livery system will be introduced in Milwaukee. The company has a capital stock of $100,000. Mr. F. R. Bacon is president; R. B. Mallory, vice-president; F. L. Pierce, treasurer, and N. S. Hopkins, secretary.

EDUCATIONAL.

UNIVERSITY OF MICHIGAN.—The senior classes in electrical and mechanical engineering will make a test of the Birmingham power station of the Detroit & Pontiac Electric Railway about the middle of February. The machinery in the power house will be tested for a complete working day.

COLUMBIA UNIVERSITY, NEW YORK.—The trustees of Columbia University, upon the suggestion of Rear Admiral Melville, Chief Engineer of the United States Bureau of Steam Engineering, have decided upon placing naval architecture in the curriculum of the School of Mechanical Engineering. Prof. Cathcart, formerly of the United States Navy, will be the head of the new department. The course will be optional to scientific students, and will include boiler design, marine auxiliaries, appliances, materials and propelling machinery, as well as architectural design and mould-loft practice. Designs for special vessels and machinery will be required as a graduation thesis from candidates for degrees. Speaking of the extension of the department's work, President Low said: "I share the opinion of the faculty that it is highly important for the university to preempt the field of marine engineering without delay."

THE GENERAL DEMAND FOR EDUCATION.—America has become the workshop of the world. Immense resources and economic methods of manufacture enable her to compete successfully with all other manufacturing countries in their own markets, and during the next few years the expansion of her trade will become the talk of the world. The great impetus recently given to all technical trades and professions by the commencement of a new era of commercial prosperity has forcibly brought to the attention of the public the great value of technical education, acquired simultaneously with practical experience. The graduate of the ordinary technical university is obliged to accept a minor position in his profession, and trust to his education for rapid advancement. But the ambitious mechanic can make immediate application of his technical knowledge and secure in the shortest possible time a lucrative position. The various engineering colleges are open to but few. Night schools are only found in the larger cities. The International system of instruction by correspondence is aimed to meet the requirements of 95 per cent. of the people, by supplying the education for which employers are willing to pay, and pay well.

NEW INDUSTRIAL COMPANIES.

THE SUN ELECTRIC MANUFACTURING COMPANY has been incorporated at Camden, N. J. Capital, $2,000. Incorporators: E. Williamson, of Media; E. Hall, G. A. Dougherty, J. R. Cantlin, all of Philadelphia, Pa.; S. Dole, of Camden.

EDISON-JOHNSON ELECTRICAL COMPANY.—The Edison-Johnson Electrical Manufacturing Company of New York City has been incorporated in New York State to manufacture electrical machinery and apparatus of all kinds. The capital is $75,000, and among the directors are Thomas A. Edison, Jr., E. G. Johnson and George H. Cook, of New York City.

BELVIDERE, N. J.—The New Jersey Construction Company has been incorporated to construct telephone and telegraph lines in Warren and other counties, and do a general contracting business. The company is capitalized at $100,000. The incorporators are Elbert B. Bohen, Easton; George R. Macey, Easton; Frank Ricker, Phillipsburg, and Michael Lynch, Phillipsburg.

ALLIANCE, OHIO.—The Morgan Engineering Company, of Alliance, Ohio, was incorporated at Columbus last Friday with a capital of $3,000,000. The company is to deal in hydraulic, pneumatic, electric, gas and power machinery, including guns and ordnance supplies. The incorporators are: W. H. Morgan, W. H. Ramsey, Mrs. Maggie M. Ramsey, Nannette Sharer Morgan of Alliance, and E. N. Huggins, of Columbus, Ohio.

LEGAL.

WRITTEN CONTRACT.—The Appellate Division of the New York Supreme Court gave judgment in favor of the North River Electric Light & Power Company in its suit against New York City upon an agreed statement of facts, to recover about $120,000 for furnishing light in the streets of the Borough of the Bronx from Jan. 1 to Sept. 30, 1890. The question before the court was whether the failure on the part of the representatives of the city to make a written contract with the plaintiff company was fatal to the latter's right to recover.

PRIORITY OF A MORTGAGE.—The Metropolitan Trust Company of New York brought suit in the Federal Court at Indianapolis against the Lake City Electric Railway Company, to foreclose a mortgage. The question is whether a bond mortgage might be foreclosed in priority to general claims against the property. The receiver of the road asserts that if the mortgage were foreclosed it would disturb the property in his possession, and in that way would be a contempt of the State Court. It was argued that the property can only be reached through the State courts. Judge Baker, of the Federal Court, held that he had jurisdiction and could permit the trust company to foreclose its mortgage, but has not as yet entered a decree to that effect.

PERSONAL.

MR. G. G. LUTHY, general manager of the Royal Electric Company, of Peoria, Ill., was in Chicago last week.

MR. SAMUEL INSULL, president of the Chicago Edison Company, has been in New York City, attending to a variety of important matters.

MR. J. B. McKEAGNE, of the J. B. McKeagne Company, Chicago, was in Philadelphia last week on business. The J. B. McKeagne Company is the Western representative of Charles Wirt & Co., and W. T. Pringle, of Philadelphia.

MR. W. W. BORMAN, the American representative of Robert W. Blackwell & Co., has just returned to this country from a trip to England. He is very busy, and speaks most hopefully of present and future conditions in the electrical field in England and on the Continent.

PROF. R. B. OWENS, of the Department of Electrical Engineering, McGill University, Montreal, has been a recent visitor in New York. Since Prof. Owens went to McGill that university has been enabled to put in a splendid electrical equipment, and is just finishing up its new electrical laboratories.

MR. W. A. FERGUSON has severed his connection with the construction department of the Westinghouse Electric & Manufacturing Company, to accept a position as electrical engineer with the Moctezuma Copper Company, Nacosari, Sonora, Mexico, the entire plant of which is to be operated electrically.

MR. ISAAC L. RICE has been elected president of the Consolidated Rubber Tire Company, to succeed Emerson McMillin. Mr. Rice said last week that he had accepted the presidency of the company upon the report made by the auditor of the company, which Mr. Rice said showed it to be in excellent condition.

MESSRS. F. H. ALDEN, president, and J. Geiserowich, secretary and treasurer of the Illinois Insulated Wire Company, of Sycamore, Ill., have been visitors in New York City during the past week, as well as in Philadelphia, etc. They have returned home after a cordial reception, and with satisfaction as to the results of their trip. They report their own line of trade as in excellent shape.

LIEUT. PAUL D. STOCKLY, of the Twenty-first United States Infantry, who was recently reported in these pages as missing in the Philippines, has now been reported by escaped Spaniards to have been seen alive in the hands of the insurgents on Jan. 28, near Antimonan, Southern Luzon. This news gives great relief to his family and numerous friends in the electrical field, who now await hopefully his liberation.

MR. A. C. TERRY, chief electrician of the Western Union Telegraph Company at the Buffalo office, has been promoted to be chief electrician of the fifth division. The headquarters of the district are at Syracuse, and this will necessitate the removal of Mr. Terry to that city. Mr. Terry has been with the Western Union Company in Buffalo for 18 years. The fifth district comprises the territory covered by the Western Union from Albany to Buffalo, and from Oswego to the Pennsylvania line. It is one of the most important districts in the company's business. Mr. Terry has recently done some important work for the company in Pittsburg, Rochester and Utica.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports a steadily increasing sale of Packard lamps.

RECEIVER APPOINTED.—Mr. William Bader has been appointed receiver of the Miller Electrical Maintenance Company of Pittsburg, Pa.

THE PARTRIDGE CARBON WORKS, Sandusky, Ohio, has gotten out a neat calendar for 1900. An attractive view of Niagara Falls is given on the card.

MR. M. I. VOUGHT, La Crosse, Wis., has just issued a pamphlet illustrating his adjustable hanger for incandescent lamps. Mr. Vought manufactures a line of electrical specialties.

THE AMERICAN ODDITY COMPANY has moved its headquarters from 381 Pearl Street to 170 West Broadway, New York, where its factories and offices are now under one roof.

THE CENTRAL ELECTRIC COMPANY, Chicago, has issued a folder briefly describing the style D skeleton bell, the improved double adjusting B. B. bell and Samson batteries—all high-grade house goods.

MR. MAX BERG has recently resigned his position with the Ohio Brass Company, of Mansfield, Ohio, and will hereafter be a partner in the firm of McGill, Porter & Berg, with headquarters at 309 Dearborn Street, Chicago.

REMOVAL.—Mr. William T. Pringle, Philadelphia, Pa., has moved from 1026 Filbert Street to the Hering Building, 112 North Twelfth Street, where he will have better facilities for the handling of his increasing business.

FRINK PATENT REFLECTORS.—I. P. Frink, 551 Pearl Street, New York, has issued a 64-page pamphlet, giving prices and illustrations of the great variety of Frink reflectors, electric signs, etc., produced by this concern.

THE A. ROSENBERG COMPANY, Baltimore, Md., has just issued a six-page folder of its water motors. One illustration shows a 9-inch motor driving a 75-watt dynamo. These motors are adapted for a great variety of power uses.

THE B. F. STURTEVANT COMPANY, Boston, Mass., has issued Bulletin S, relating to the Sturtevant four-pole motors and generators for direct current. The machine complete, and its armature, are illustrated. Dimensional diagrams are also given, together with tabulated data.

THE STANDARD UNDERGROUND CABLE COMPANY is pushing the work on its branch factories at Perth Amboy, N. J., and at Oakland, Cal., as rapidly as possible, because the orders have been coming in so fast lately that the company is in great want of additional facilities.

THE KESTER ELECTRIC MANUFACTURING COMPANY, 251 South Jefferson Street, Chicago, is doing an excellent business with its "Kester's" self-fluxing solder. This solder is intended particularly for electrical work. It makes a secure, sound and non-corrosive joint.

THE PHOENIX BATTERY MANUFACTURING COMPANY.—Mr. A. N. Barron, of Cleveland, Ohio, has purchased all the merchandise, tools, patents and other property of the Phoenix Battery Manufacturing Company, St. Louis, Mo., except its real estate and rights in the Anderson patents. Mr. Barron's bid, being the highest, was accepted by the assignee.

THE MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York, has printed an interesting folder calling attention to the valuable service rendered by this cable in the Pulitzer residence, which was recently burned in New York. The alarm was promptly sounded by the action of the cable, and although it was quite early in the morning, every one in the building was enabled to escape. The two persons who were suffocated returned to the burning building after once leaving it, and thus lost their lives.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, are mailing to the trade a small and very complete net price list, covering everything staple, and that would be necessary for all general work. It is a handsomely bound compact book of 64 pages, of a size suitable for carrying in the pocket, and is handy for quick reference. The prices are all net, and can be read at a glance, thus saving all figuring of discounts, etc. Copies will be mailed on application.

THE CONSOLIDATED ELECTRIC LAMP COMPANY has been incorporated at Danvers, Mass., to conduct a business of renewing incandescent lamps. The capital stock of the company is $100,000. The company at present employs thirty persons, making an average of 1000 lamps a day, and will at once increase its output to 1500, having orders on hand for over 125,000 lamps. It will at once enlarge its capacity, increase equipment, and probably will purchase or erect a building, although this matter is undecided. Liberal inducements to remove to other places have been received and are under consideration.

THE NON-POLARIZING DRY BATTERY COMPANY, 625 Broadway, New York, has just received an additional order for 1000 "O. K." dry cells from the War Department, U. S. Signal Office. This battery, after undergoing a thorough and competitive test, conducted under the auspices of the Navy Department, was adopted as the government standard dry battery. The company exhibits a letter from the captain and signal officer of U. S. Volunteers, stating that the use of "O. K." cells has been most satisfactory, and that they have used this cell exclusively in Cuba and Puerto Rico, as well as in the Philippines.

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY have just issued their fuse wire catalogue No. 11. Attention is called to the fact that they have made some additions in this issue, in the way of information about their line and method of packing, and have included extracts from the rules of the National Board of Fire Underwriters, relating to the use of fuse wire and links. The product of the Chicago Fuse Wire & Manufacturing Company has been favorably known for many years. Their goods are sold through the prominent jobbers and dealers in electrical goods. A copy of the catalogue will be sent free to all applicants.

MR J. S. NOWOTNY, Cincinnati, Ohio, has purchased the good will, including all of the patents and application for patents and patterns, etc., which gives him the control of all the previous rights as enjoyed by the Nowotny Electric Company in the manufacture of the Nowotny enclosed arc lamp and other electrical specialties. Mr. Nowotny has made some important improvements in the Nowotny arc lamps, and has much better and increased facilities for their manufacture. He has a large stock of these lamps, as well as globes and supply parts from which to fill immediate orders, and will take pleasure in sending catalogues and quoting prices. His address is 105 East Pearl Street.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has just issued a neat 56-page catalogue of Emerson fan motors of various classes and styles. As is well known, these machines are designed for alternating current. In general appearance the Emerson fan motors for this season will be very similar to those of last year's model, but in many ways they have been improved. The desk fan is equipped with the Parker noiseless blade. The switch of last year has also been improved, and the wires can now be more easily attached. These fans are made in the following named classes: Desk, ceiling and exhaust, each of different styles and sizes. They run on 7200 and 16,000 alternations. The various classes of fans are very well illustrated and clearly described.

THE GALVANIC METAL PAPER COMPANY, 61 Washington Square, South, New York, is meeting with an increasing demand for its packing, which

is intended for use in stuffing boxes of engines, pumps and other machinery. A recent letter received by the company from the Sone & Fleming Works, of the Standard Oil Company, at Greenpoint, L. I., refers to the packing in high terms. This packing is used by the United States Navy for transport service, the Central Railroad of New Jersey, the New York Central & Hudson River Railway, the White Star line, the Havana Steamship Company, etc. This packing was described and an illustration shown of its application in these columns on Sept. 2, 1899.

ELECTRIC SIGNS.—One of the most successful methods of attracting the attention of the public is by the use of electrically illuminated signs, and that this form of advertising is appreciated by the business community is evident from the number of these signs that is to be seen at night in many cities throughout the country. This form of sign renders it possible to impress a certain amount of individuality on the design, which necessarily results in attractive variety. The Electric Motor & Equipment Company, 12 Beaver Street, Newark, N. J., has made a specialty of this class of work for some years; also of novel electrical devices for show windows, displays, etc. This company claims to be the pioneer in the electric sign business, and among the well-known signs of its make are those on the high wall at the junction of Broadway, Fifth Avenue and 23d Street, New York, and of B. T. Babbitt's Soap Works, which is familiar to visitors to New York and others crossing the North River at night.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, have recently made their first large shipment of Peerless fans for 1900 use. Manufacture of the 1900 product has been going on for a long time, and the first filling of the orders is but the beginning of large shipments which the demand for this fan has made necessary. Every Peerless fan that is turned out by the manufacturers is guaranteed, and the early orders the company has received show that there will be a large distribution of them throughout the entire world this year. The representatives of the company who handle the Peerless products in different parts of the United States are all well-known concerns, and the placing of the output in the hands of responsible parties has added materially to their ready acceptance by purchasers generally. Various styles and types of the Peerless fans have been made by the Warren Company. One of them is a ceiling fan with four blades and electrolier attachment. All of the ceiling fans have two speeds, except that form operating at 500 volts, with the speed regulating switch placed at the bottom of the electrolier, where it is easy of access. During the winter months, when a fan is unnecessary, the motor may be taken out entirely, leaving a complete electrolier. Another style of fan is that for desk use, which is made with a swivel, so that by adjusting it the breeze may be turned in any direction without the necessity of moving the machine itself.

SHELBY TUBE.—The Shelby Steel Tube Company has recently acquired the assets, patents, and processes of the Newcastle Tube Company, Auburn Nut & Bolt Works, Hercules Seamless Tube Company, the Pope Tube Company, Tubing Department of the United States Projectile Company, Tubing Department of the Mansfield Machine Works, the Ellwood Weldless Tube Company, the Greenville Tube Company, the American Weldless Tubing Company of Toledo, the Brewer Seamless Tubing Company of Toledo, the United States Standard Drawn Steel Company, the Shelby Tube Company of Ohio, and the Albany Manufacturing Company of Albany, Ind. The reorganized company is authorized to issue $15,000,000 capital stock—$6,000,000 preferred and $9,000,000 common. Only $5,000,000 in preferred and $8,150,000 common stock is to be issued at this time. Stockholders of the old Shelby Company receive no cash, all taking new stock, the terms being one-half share of new preferred and three-quarters of a share of new common for one share of old stock. The capitalization of the old company is $7,376,400. The directorate of the new company is as follows: W. E. Miller, Cleveland; Albert A. Pope, Boston; R. L. Coleman, Chicago; H. A. Lozier, Cleveland; B. J. Williams, Shelby; E. W. Bliss, Brooklyn; L. S. Hoyt, Newcastle; John L. McKinney, Titusville; F. J. Carolan, San Francisco; Frank O. Lowden, Chicago; James B. Dill, East Orange. The new company will be officered by those now holding executive positions with the old company. President, W. E. Miller; treasurer, W. S. Miller; secretary, H. H. Cockley. N. A. Gilbert will be general counsel.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JAN. 30, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Building, N. Y.]

642,123. DYNAMO-ELECTRIC MACHINE; Ernst Wilhelm Gustav Carl Hoffman, of Charlottenburg, Germany. A support for the stationary member is provided whereby the frame can be turned concentrically so as to bring into convenient position any part requiring examination or repair.

642,216. UNIT MULTIPLE SYSTEM OF CONTROL FOR ELECTRIC RAILWAYS; Frederick C. Esmond, of New York, N. Y. App. filed Sept. 27, 1898. A pair of conductors extend through one or more cars to which the motor field is connected, with the armature tapped into the middle of the field. A controller is connected to a source of current, and also to a reversing switch, whereby current may be sent through one-half of the field in either direction.

UNITED STATES PATENTS ISSUED FEB. 6, 1900.

642,570. UNDERGROUND ELECTRIC RAILWAY; W. J. Baumer & H. Emmel, Johnstown, Pa. App. filed Oct. 5, 1899. A conduit extends between the rails and on top of it the contact boxes rest. The invention resides principally in the internal arrangements of the switch boxes.

642,589. DYNAMO DRIVING MECHANISM; R. M. Dixon, East Orange, N. J. App. filed Sept. 14, 1898. By the use of a centrifugal apparatus and a clutch the armature shaft is driven by the car axles only when the latter is running at a high rate of speed.

642,599. DYNAMO ELECTRIC MACHINE; Henry Geisenhorner, of Schenectady, N. Y. App. filed Nov. 7, 1898. Several outside lamini of a toothed armature have grooves pressed in the tooth projections in order to prevent the same from bending over.

642,623. HANGER FOR ELECTRIC LAMPS; W. F. Murphy, Iowa City, Ia. App. filed May 15, 1899. The cord supporting the lamp is wound upon a reel, which is fitted with a retaining device similar to a curtain fixture.

642,627. ELECTRIC LIGHTING SYSTEM; A. C. M. Prücker, of Hanover, Germany. App. filed Sept. 2, 1899. The lamps in accordance with this invention each have that terminal which is connected with one of the main conductors, enclosed so as normally to be inaccessible, the other terminal of the lamp constituting the casing for the plug portion thereof, is connected either directly with the ground at the district of distribution or with the compensating conductor of a three-wire system. In this way the exposed contact may be employed without danger.

642,648. ELECTRIC LIGHTING DEVICE; G. W. Van Duzer, Hackettstown, N. J. App. filed April 27, 1899. A lighting outfit for orchestras consisting of a portable battery and lamp connected thereto by flexible cord and arranged so that it may be attached to a musical instrument in a position to throw light upon the music sheet.

642,662. APPARATUS FOR ELECTRICALLY TRANSMITTING ORDERS OR SIGNALS; A. U. Alcock, London, Eng. App. filed Jan. 6, 1899. For transmitting orders according to this invention there are used, in conjunction with two circuits, means for causing periodically varying electric currents to traverse the circuits, a transmitting instrument comprising an indicator arranged to move over a dial, and a circuit disturber connected to the indicator and adapted to vary the condition of the two circuits at the transmitting end thereof, and a receiving instrument comprising an indicator arranged to move over a dial, and a circuit balancer adapted to restore the balance in the condition of the two circuits at the receiving end thereof.

642,663. MEANS FOR GENERATING OZONE; C. G. Armstrong and W. D. Neel, Chicago, Ill. App. filed March 12, 1898. (See News and Notes.)

642,674. ELECTRICAL RECORDING APPARATUS; H. L. Callendar, Montreal, Canada. App. filed Feb. 14, 1898. This method of recording electrical quantities is directly applicable to those cases in which the measurement is effected by sliding a contact piece along the wire resistance forming part of an electrical circuit, until a point is found at which the value of the electrical potential is the same as at some other given point. The improvements described relate to means by which the contact is automatically maintained always at the balance point, to the adjustment of the scale of the record, and the construction of the apparatus in such a manner as to make the application as general and accurate as possible.

642,697. ELECTRICAL TRACK FOR RECEPTACLES; C. Hutchinson, of Arlington, N. J. App. filed Nov. 14, 1898. This invention is adapted for cash carriers and similar small work, the novelty residing in the use of a wire conductor, a contact strip, and current reversing devices operated at any desired point of the track.

642,737. ELECTRIC RAILWAY; E. Bonnet, J. Paufique and G. Liniere, of Lyons, France. App. filed July 11, 1899. A surface contact system in which a magnet carried by the car makes mechanical contact with boxes in the roadway, the magnet serving to close a switch in the box and so give current to the car. The invention consists in energizing the magnet by storage battery on the car, which is reinforced as soon as the motor circuit is closed by the main current.

642,738. ELECTRIC CABLE FOR HIGH TENSION CURRENTS; C. Borel, Lyons, France. App. filed Dec. 13, 1898. The conductor comprises a cylindrical central core composed of a plurality of bare wires in contact with each other, a plurality of exterior wires encircling the core and slightly insulated therefrom, and a thin insulating covering around the outer wires, all wires carrying the same current.

642,743. COMMUTATOR FOR ELECTRIC MOTORS OR GENERATORS; S. Evershed, London, Eng. App. filed Sept. 15, 1899. The commutator has conducting strips of resilient wires fixed at one end in an insulating collet, and free to bend at the other; the brushes are disks, the edges of which make rolling contact with the wire strips.

642,804. ELECTRICALLY IGNITING LAMPS AND LIQUID FUEL BURNING DEVICES; R. Schreiber, Berlin, Germany. App. filed July 30, 1898. The igniting device is a spiral near the upper edge of the lamp wick, which may be raised and lowered with the wick.

642,809. TELEPHONE SWITCHBOARD; E. E. Yaxley, Chicago, Ill. App. filed July 26, 1898. The feature of novelty is that of housing the wire connections of the parts in recesses or chambers formed in the sides or between adjacent sides of the switchboard section, wherein the wires are out of the way, are protected and are easily accessible for repair.

642,819. APPARATUS FOR PRODUCING SPECTACULAR EFFECTS; W. Freeze, New York, N. Y. App. filed July 26, 1899. This is a device adapted to be rotated by hand, having electric lamps mounted thereon and carrying contacts, one of which is at a pivotal center and is to be used in connection with a pivot rod making contact with the pivot center and with an insulated contact for making traveling connection with the other contact on the rotating device. The apparatus is for theatrical purposes.

642,825. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; W. E. A. M. Oetting, of Pittsburg, Pa. App. filed Sept. 16, 1899. The cap of the socket is held in place by spring clips formed on the body of the socket.

642,826. CARBON FOR ELECTRIC ARC LIGHTS; J. T. Robinson, New York, N. Y. App. filed Aug. 2, 1898. (See Current News and Notes.)

642,844. PUSH BUTTON FOR BATTERY INDICATORS; G. Heidle, St. Louis, Mo. App. filed Jan. 28, 1899. For holding the circuit closed temporarily, the push button has a lateral movement which causes it to engage with a latch and hold it in its inner position.

642,848. RAILWAY SIGNAL MECHANISM; S. L. Neely, of Pierron, Ill. App. filed May 10, 1899. The invention consists of a bell, inside of which the electro magnetic ringing mechanism is located.

642,849. ELECTRICAL MASSAGE INSTRUMENT; E. T. Otto, Jersey City, N. J. App. filed Nov. 27, 1899. The instrument consists of a handle carrying a divided roller, the parts of which are the terminals of a circuit leading to an induction coil and battery located in the handle.

642,859. SYSTEM OF ELECTRICAL DISTRIBUTION; Henry P. White, of Kalamazoo, Mich. App. filed Sept. 26, 1898. An alternating current is split by means of an inductance into two currents differing in phase by 90 degrees, which currents are then combined to form a direct current by means of a rectifier, or commutator having synchronous speed.

642,863. DRIVING MECHANISM FOR DYNAMOS; J. L. Creveling, New York, N. Y. App. filed Jan. 24, 1899. This invention consists of a pulley operatively movable with respect to the axle as well as the dynamo, and having a definite or positive operative relation with the armature shaft throughout its different movements and bearing what may be called an "accommodating" operative relation to the axle whereby joltings of the car will not cause slipping or straining of the belt.

642,869. CONTROLLING MEANS FOR SPARK GENERATORS; H. N. Motsinger, of Pendleton, Ind. App filed April 21, 1899. A centrifugal device is used to control the speed of a spark generator for gas engines.

642,880. CONNECTION REGISTER FOR TELEPHONE LINES; C. E. Scribner, of Chicago, Ill. App. filed Feb. 14, 1898. This invention concerns the recording of uses of party lines, there being located at each station on the line a differential device which operates when the subscriber uses the instrument, to cut out the recording device at the other stations on the line, and to record only for the station in use.

642,911. ELECTRIC LAMP SUPPORT; H. Long, of Greentown, Ind. App. filed Oct. 5, 1899. Invention consists of the details of construction of a raising and lowering device.

642,913. ELECTRIC ALARM TRY COCK; S. M. Mathews, of Toronto, Canada. App. filed April 14, 1899. The device is provided with an expansion chamber in communication with the boiler, a sealed air chamber contiguous to the expansion chamber, a diaphragm actuated by the air in the sealed chamber and an adjustable contact screw in circuit with a battery and alarm through which the circuit is completed when the air in the sealed chamber is expanded to move the diaphragm into contact with the screw.

642,932. ELECTRIC CURRENT CONTROLLING MECHANISM; C. W. & J. B. Squires, of Springfield, Mass. App. filed March 15, 1899. This is a special arrangement of circuits for operating a switch throwing mechanism on trolley roads.

642,934. TELEPHONIC INSTRUMENT; F. A. Swan, of Boston, Mass. App. filed May 3, 1899. This is a small automatic exchange system in which each subscriber is provided with a casing through which projects a number of push rods or circuit controllers, one for each station in the system. The push rods co-operate with a rotatable wheel mounted to oscillate within the casing and controlling the circuits of the system.

642,953. ELECTRIC BATTERY; H. Blumenberg, Jr., and F. C. Overbury, New York, N. Y. App. filed March 27, 1899. (See Current News and Notes.)

642,982. MOUTH PIECE FOR TELEPHONE TRANSMITTERS; G. B. Hart and F. W. Milligan, Rochester, N. Y. App. filed March 7, 1899. The mouth piece is arranged to receive a disinfecting pad which is easily removable therefrom.

643,087. ELECTRIC GENERATOR FOR SPARKING APPARATUS OF GAS ENGINES; D. Drawbaugh, Eberly's Mills, Pa. App. filed May 6, 1899. The armature is constructed so that as the current from one section is decreasing the current from the other section is increasing in the same ratio, the result being a uniform current to line.

643,093. ELECTRIC MOTOR; J. C. Henry, of Westfield, N. J. App. filed Aug. 27, 1892. In connection with two electric motors each having pairs of pole pieces a switch is used to connect the motors in series or in parallel and to alter them from bi-polar to four-pole, or vice versa.

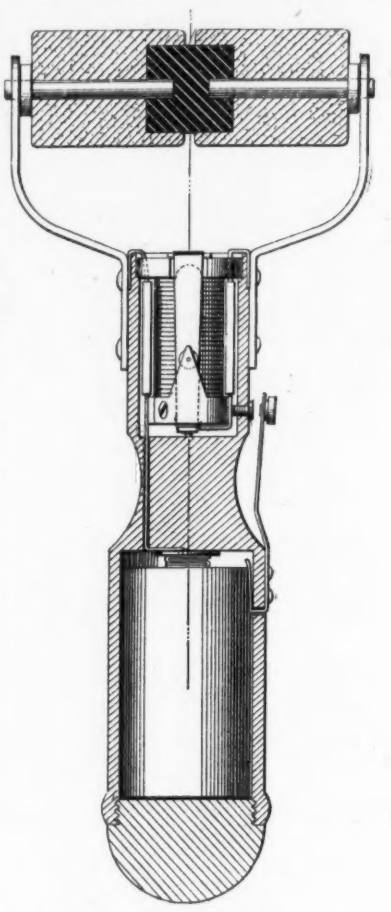
643,095. MAGNETO ELECTRIC LIGHTING APPARATUS FOR BICYCLE; S. L. Holdrege, of Boston, Mass. App. filed June 30, 1898. Details of construction adapting the machine for its particular use.

643,096. PROCESS OF RECOVERING GOLD AND SILVER FROM CYANID SOLUTIONS BY ELECTROLYSIS; S. B. Christy, Berkeley, Cal. App. filed Feb. 9, 1898. The process of progressive electro-concentration and recovery of gold and silver contained in the large volumes of dilute cyanid solutions containing free alkali resulting from the extraction of gold and silver ores, tailings and concentrates, which consists, first, in depositing the gold and silver electrolytically from said solution upon removable cathodes sufficiently numerous and large in area to secure efficient deposition, and second in making said removable original cathodes successively anodes in a smaller volume of cyanid solution and transferring and depositing electrolytically the thin film of gold and silver, already distributed over a large number of said original cathodes, upon a smaller number of secondary cathodes, also contained in said smaller volume of cyanid solution.

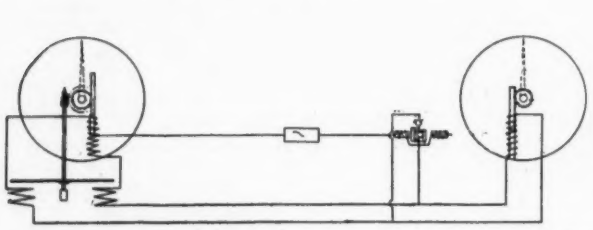
GERMAN PATENTS, ISSUED JAN. 24, 1900.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

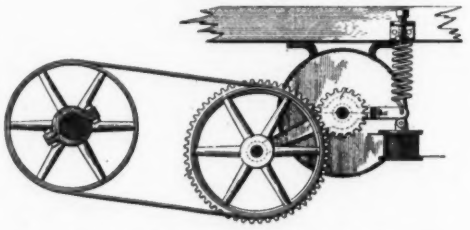
106,422. SYSTEM OF DISTRIBUTION; Benjamin Garver Lamme, Pittsburg. App. filed Jan. 17, 1899. In order to make the compounding of dynamos independent of the distance of the places of consumption, the more distant stations are fed by the whole current, whereas the nearer are fed only by part of the same.



106,680. ALTERNATING CURRENT TRANSFORMER; Société Anonyme Pour la Transmission de la Force Par L'Electricite, Paris. App. filed Feb. 22, 1899. The transformer is adapted for n polyphase currents of any suitable pressure and shifted $\frac{I}{n}$ of a period into K secondary polyphase currents of any desired pressure and shifted $\frac{I}{K}$ of a period, and vice versa. It consists of K secondary circuits, all having the same number of turns; each one has n magnetic cores, in which, by means of n primary circuits, there are developed n independent groups of lines of force, the changes of which in regard to the time of successive differences of phase are represented by $\frac{I}{n}$ of a period.



642,662.—Apparatus for Electrically Transmitting Orders or Signals.



642,863.—Driving Mechanism for Dynamos.

642,849.—Electrical Massage Instrument.

642,995. ELECTRIC CONNECTING DEVICE FOR LAMP HOLDERS, WALL PLUGS, ETC.; C. L. R. E. Menges, La Hague, Netherlands. App. filed March 14, 1898. Specific construction of the devices for holding the lamp or plug in place.

643,000. BRUSH HOLDER; P. O'Shaughnessy, of New York, N. Y. App. filed March 14, 1899. The brush holder consists of a bracket, one or more brush clamps mounted thereon, there being a sliding contact between the clamp and the bracket and a lock nut for graduated adjustment of the contact.

643,018. UTILIZATION OF HERTZIAN OR SIMILAR RADIATIONS AND APPARATUS THEREFOR; Louis Heathcote Walter, of London, England. App. filed March 6, 1899. To both transmitter and coherer of usual type are attached apparatus which, when released, give approximately synchronous motion to disks. On the transmitting disk are sparking projections corresponding to contact points on the receiving disk. Unless a certain codal method of transmitting sequels is followed, the receiving instrument will not accomplish its purpose of firing a mine or similar purpose.

643,066. ALTERNATING CURRENT MOTOR; W. Langdon-Davies, London, England. App. filed May 22, 1899. (See Current News and Notes.)

106,707. DEVICE FOR REGISTERING UNAUTHORIZED USE OF TELEGRAPHIC INSTRUMENTS; Franz Kolm, Berlin. App. filed Sept. 16, 1898. The key of the instruments is provided with a stylus, which produces a visible impression on, for instance, a strip of paper placed underneath the key in a closed box, and moved by a suitable clockwork.

106,896. RECORDING TELEPHONIC TRANSMISSIONS ON A PHONOGRAPH CYLINDER; Raimund Gunther, Wien. App. filed Dec. 17, 1898. The subscriber of a telephone station in case of his absence, cuts out the call-bell and the receiver and connects instead of these an electromagnetic retarding device for the clockwork of a phonograph and also the recorder of the latter. By the call of another subscriber or the central station, the call-bell will not work and the telephonic impulses will be recorded upon the cylinder of the phonograph by the stylus connected to the diaphragm.

106,897. METHOD OF RUNNING ALTERNATING MACHINES BY ALTERNATING-CURRENT DIRECT-CURRENT TRANSFORMERS; W. Lahmeyer & Co., Frankfurt a/M. App. filed April 5, 1899. Every phase of the transformer is fed from current-sources placed in series, the phases of which differ from each other, whereby the pressure of one of these sources is controlled by the current furnished by the machine.